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The Caproni Epoca

THE Caproni flying boat Epoca, which is shown on the front cover of this issue is in many ways the most original type of aircraft that has been produced to date. Its originality lies not so much in its great size as in its general lay-out. In fact, in the matter of size and horsepower the Epoca, with its wing span of 108 ft. and its eight Liberty-12 engines, will be largely exceeded by the GB-1, the giant flying boat now under construction for the United States Navy, for this will have a span of about 150 ft and a power plant composed of nine Liberty-12 engines.

However, the general lay-out of the Epoca differs fundamentally from the GB-1—and from any other heavier-than-air craft as well To begin with, the hull of the Italian flying boat runs the entire length of the machine, a matter of 66 ft. On this hull there are mounted, in a double tandem arrangement, three triplane cells with a total lifting area of 7,150 sq. ft. The forward and after cells are apparently mounted at the same height above the hull and are fitted with ailerons, while the middle cell is mounted on a lower level and has no ailerons. Several rudders are fitted in the after cell, but there is no tail, properly speaking, the rear ailerons being apparently entrusted with providing for longitudinal control

This arrangement is, of course, a radical departure from orthodox practice. The tandem wing setting, which originated with Prof S. P. Langley's steam-driven airplane models, in 1896, and which that savant later incorporated in his man-carrying machine, has yet to demonstrate its efficiency Its stability is readily conceded, but this does not necessarily imply controlability Aerodynamical interference between following wings greatly detracts from their practical value and with the great size and large parasite resistance to be found on the Epoca this will represent an important item. Whether the lowering of the middle cell with respect to the forward and aft cells will overcome this inherent defect of following wings remains to be seen.

The bracing of the wing structure is of conventional design, with a series of wires inter-connecting the cells. Along the middle wings of the cells two fuselages run the entire length of the machine and house the power plant, which consists of eight Liberty engines. Four are fitted forward and four aft, with three tractors and three pusher propellers.

As far as streamlining and aerodynamic efficiency are concerned, this giant boat, with its large number of wires and struts, and its numerous engine nacelles, is a retrogression. But, perhaps it is too much to expect refinements of design on such a wholly experimental type. Apparently the designer's underlying thought was that by the use of three triplane cells spans and weights of lifting surfaces would be cut down to a minimum. At the same time, the weights in this type of construction being distributed longitudinally, this would further reduce bending moments and weights. The resulting decrease in structural weight explains the enormous useful lift with which this machine is credited—100 passengers or fuel of 5,000 miles—and so may the adoption of small factors of safety. This seems to be born out by the structural failure which occurred on the trials of the Epoca.

Despite this initial failure the further progress of the Epoca type deserves to be watched with sustained interest. However great the difficulties that must be overcome in order to make such a machine airworthy, nothing would be more stimulating than to witness the success of the experiment, for it would open up untrodden roads to airplane construction.

Factors Effecting Minimum Speed

AS a rule it is customary to consider minimum speed as affected by the loading per square foot and the maximum lift coefficient of the wing Quite a number of other points, however, enter into the determination of the minimum speed, and the recent N.A.C.A. report by F A. Norton is highly interesting from this point of view

The report recommends that consideration be given to the effect of slip-stream, but also states that this effect is very small The vertical component of the airscrew thrust may also improve the landing speed. Excess power at low speeds gives the pilot more confidence in coming right down to bottom speeds. But above all, ample longitudinal and lateral control at low speeds are important, as when a plane is flying at a large angle of incidence, the ailerons become ineffective. The rudder is a little better off and so is the elevator The more powerful all these controls are, the less danger is there for a machine going out of control at low speeds.

These various factors are very well brought out in the report and are well worth studying by designers.

French State Assistance to Aviation

The provisions of the new French subsidy system for commercial aircraft, which are printed in this issue, are characteristic of the comprehensive manner in which commercial aviation is being fostered by the French government. Whatever the merit or demerit of state subsidies, it cannot be gainsaid that France is making a bold and determined move with a view to become supreme in the air. That it is proposed to achieve this result by means of commercial air supremacy instead of by the maintenance of a huge air force, which would be unproductive in times of peace, merely shows breadth of vision. A flourishing air transport fleet not only keeps pilots in training and thus affords in time of war a valuable reservoir of trained personnel; it also enables the aircraft industry to attain a healthy development. As a consequence, on the beginning of hostilities the regular air force has the physical means for rapid expansion, which a country devoid of a commercial air fleet would naturally lack. The assistance the French government grants its commercial aviation is therefore a striking illustration of foresightedness.

The Development of Aircraft

With Special Reference to the Zeppelin Airships

By P. Jaray

Translated by Starr Truscott, Aeronautical Engineer, Bureau of Construction and Repair, Navy Department

(Concluded from our last issue)

(B) Numerical Representation of the Development

Comparisons will now be made, on the basis of figures obtained from practice, which will characterize numerically the development of aircraft in the directions indicated. The airship, which has been treated in a rather stepmotherly manner by the press, will be discussed somewhat more completely. This appears the more necessary since the airship—and especially the Zeppelin airship—seems at present to be better adapted for transportation over intermediate and longer distances than the airplane.

It is of course possible that the margin of superiority will shift somewhat in favor of the airplane with its further development, but apparently the opposite is probable. The following figures show plainly enough something which the author made known in influential quarters in 1914, namely that the economy of the airplane from a technical and economical point of view either decreases with increase of size or remains very nearly unchanged, while with the airship the economy increases rapidly with increase of size. In the numerical analysis of the development besides the ratios $\left(\frac{\eta}{\xi}\right)$ (and $\frac{\eta}{\psi}$) γ, λ and ω data as to general dimensions, power and speed are also required, consequently, these must be assembled first. The following arrangement will be developed

DEVELOPMENT

(a) The Airship — (b) The Airplane
- (I) From a technical point of view
  - (1) Dimensions
  - Gas volume — Plane area
  - (2) Power
  - (3) Speed
    - With 1, 2 and 3 the aerodynamic coefficient
  - (4) Useful load
    - With 1 and 4 the structural coefficient
    - With 1 to 4 the efficiency
- (II) From the economical point of view
  - With the Profit Rating (Economic Coefficient)

I 1 a. The first beginnings of airship navigation—with ships of less than 10,000 cu m volume—will not be considered here. The beginning of the development of the airship can be assumed to coincide with the first Zeppelin airship, which in 1900 had a volume of 10,300 cu. m. Since the Zeppelin airships held the lead substantially throughout the whole development, the dates of the individual types will be briefly mentioned in connection with the list of types silhouettes.

The increase in size took place slowly at first. A volume of about 20,000 cu. m. was first reached with type *h* (LZ-14) and with the exception of type *i* (LZ-18) was kept until type *m* (the last ship of 22,740 cu. m., LZ-37). Then there followed rapidly one after another

Type *n* (LZ- 26) of 25,000 cubic meters at the end of 1914,
Type *p* (LZ- 38) of 31,000 cubic meters at the beginning of 1915,
Type *q* (LZ- 59) of 35,800 cubic meters at the end of 1915,
Type *r* (LZ- 62) of 55,000 cubic meters at the middle of 1916,
Type *w* (LZ-102) of 68,500 cubic meters at the middle of 1918.

Even if these increases in size are to be attributed principally to the demand for greater altitudes in the military ships, nevertheless there were thereby created aircraft of greater carrying capacity, which could in a similar manner satisfy the requirements of a means of transportation, carrying a large useful load with a large radius of action. Type *w* moreover actually had to fulfill in war time the function of a cargo airship, and the journey of the L-59 (LZ-104) from Jamboli, (Bulgaria) to the former German East Africa —without taking on any fuel and in about 100 hours out and back—very plainly showed its suitability for the purpose.*

The other airship building concerns can also record increases in the volume of their ships but they reached dimensions similar to those just given much later. The British for instance in the beginning of 1919 brought out their type R-33 and 34, which, on the occasion of the crossing of the Atlantic Ocean, was referred to in many papers as the largest type of airship, although they were of only 55,200 cu. m. volume.

The largest Zeppelin airship for inland traffic, the Bodensee, shows a decrease in dimensions. It was built of 20,000 cu. m. gas volume for travel over shorter and intermediate distances (up to 1650 kilometers) and naturally is better suited for this than a larger ship.

I 1 b. The story of the airplane begins with the first flights of the Wright Brothers in December 1903.

The increase in size of the airplanes has turned out somewhat differently from that of the airship. The wing area of 48 sq m of the Wright airplane is still to be found in modern airplanes, although at the same time airplanes of greater—but also smaller—dimensions are being built. Up until the beginning of the war the Sikorski machine with about 150 to 240 sq m of plane area was the largest, if the Maxim plane of 1894 is neglected. These are however, far exceeded in size by the German Giant airplanes and by foreign machines. The former has about 320 sq. m. of plane area and as far as published data indicate planes of over 430 sq. m. plane area have already been constructed.

I 2 a. The development in engine power shows an increase with increasing size of the airship, and even faster than the volume. If the type *a* Zeppelin airship of 30 hp. is neglected (see Table III), then types *b* with 170 hp. or 210 hp., *c* with 210 hp. and *d* with 230 hp. had about 014 hp. to 017 hp. per cu. m. of gas volume, *e* with 370 hp., *f* with 450 hp., *g* with 510 hp., to finally *r* inclusive with 1440 hp. had about 023 to 030 hp. per cu. m. of gas volume. Types *s*, *t*, and *u* with 1200 hp., however, in spite of further increase in size, had only about 021 to 022 hp. per cu. m., as also type *v* with the same power. With 1450 hp. this type of course again had 026 hp. per cu. m. Finally type *w* had, with 1200 hp., only 0175 hp. per cu. m. while type *x* with 2030 hp. required nearly 033 and *y* with 2960 hp., even 048 hp. per cu. m. although *x* had about three times the gas volume of *y* and both types had about the same speed. From type *g* on the engine power increases approximately directly with the increase in size of the airship,—which would probably be the case with every new type—in spite of a simultaneous increase in speed with the increase in gas volume. This alone gives an indication of the increase in economy with increase of size. With the same speed the expenditure of weight and fuel for the engines, referred to the total weight of the airship, is the smaller the greater the volume of the ship. The degree of this relation will be taken up specially later.

I 2 b. With increase in size of airplanes thus far there has been either no, or no important, decrease in the ratio of power required to total weight, if the figures are referred to the same speed. In absolute magnitude the Horse Power figures reach about the same size as in airships. Beginning with 16 hp. in 1903 the power increased rapidly to 30, 50, 80, 100, 180, 200 hp. In 1914 it had already reached 400 hp. and today stands at about 2000 hp.

I. 3 a. In airships the speed has been increased principally by decreasing the resistance. At the beginning—in the Zeppelin airships up to type *p*, (compare again Table III)—the increase in power was of course the determining factor. Even though the increase in speed was always clearly purchased, it was very considerable. Neglecting type *a*, types *b* to *e* had speeds of 12 to 17 meters per second, types *f* to *n* about 21 to 24 meters per second, type *p* reached 27 meters per second, while type *q* on account of the increase in length of the hull reached only 26½ meters per second with the same power. Type *r* reached 28.7 meters per second. After a reduction of engine power *s* had only 27.7 meters per second while through further improvement *t* again reached 28.9 meters per second.

Principally because of the use of better propellers type *u* attained 29.6 meters per second and type *v* because of further reduction in resistance with simultaneous increase of engine power, 31.8 meters per second. The highest speeds yet, of 36.4 and 36.8 meters per second, which is over 130 kilometers per hour, have been obtained with types *x* and *y* which, with entirely different sizes, have about the same aerodynamic properties.

I 3 b. The speed of airplanes,—as far as the smaller and middle sized planes are concerned—is today far above that of the airship. The first machines attained a speed of about 20 meters per second. Only in the beginning of 1910 was 25 meters per second reached, although the middle of 1910 saw 35 and the end about 40 meters per second. At the middle of 1911, 45 meters per second could be made and finally at the end of 1913 some racing craft achieved about 55 meters per second. Since then speeds of 70 meters per second and above have been reached, with which however, very serious landing difficulties have arisen even with small airplanes.

THE AERODYNAMIC COEFFICIENT

(a) The aerodynamic coefficient which was derived in the foregoing as the ratio of Propulsive Efficiency to Coefficient of Resistance $\left(\frac{\eta}{\xi}\right)$ or $\left(\frac{\eta}{\phi}\right)$ begins at 9.0 with LZ-2 (compare Table III, Fig. I and Fig. 3). After the ensuing reconstruction of LZ-3 it decreases to 7.7 because of the increase in length and the higher engine power with the same propellers. This type of ship, type *b*, has the lowest aerodynamic coefficient $\left(\frac{\eta}{\xi}\right) = 7.7$. Type *a* (LZ-1) is not considered as it can

TABLE III
CHARACTERISTICS OF THE ZEPPELIN TYPE AIRSHIPS BUILT FROM 1900 TO 1919

Type	L Z No.	Year	Volume cu. m.	Length m.	Dia. m.	Gas Cells	Engines	Total hp.	Propellers	Speed m./s.	Disposable Lift tons, metric
a	1	1900	11,300	128.6	11.7	17	2	30	4	7.6	
b	3	1905	11,300	128.0	11.7	16	2	170	4	12.3	2.8
c	4	1908	15,000	136.0	13.0	17	2	210	4	13.6	4.5
d	6	1909	15,000	136.0	13.0	17	2	230	4	13.6	4.2
e	7	1910	19,300	148.0	14.0	18	3	370	4	16.7	6.8
f	8	1911	17,800	140.0	14.0	17	3	450	4	21.0	7.0
g	11	1912	18,700	148.0	14.0	18	3	510	4	23.0	6.5
h	14	1912	22,470	158.0	14.9	18	3	495	4	21.2	9.4
i	18	1913	27,000	158.0	16.6	18	4	720	4	21.0	11.1
k	21	1913	20,870	148.0	14.9	17	3	540	4	20.5	6.6
l	26	1914	22,160	156.0	14.9	18	3	540	4	20.0	8.5
(3)m	24	1914	22,470	158.0	14.9	18	3	630	4	23.4	8.3
(4)n	26	1914	25,000	161.0	16.0	18	3	630	3	22.3	12.2
o	36	1915	24,900	161.4	16.0	18	3	630	3	23.0	11.1
p	38	1915	31,900	163.5	18.7	18	4	840	4	26.7	16.2
q	59	1915	35,800	178.5	18.7	18	4	960	4	26.5	17.6
(5)r	62	1916	55,200	198.0	23.9	19	6	1440	6	28.7	32.0
s	81	1917	55,500	196.5	23.9	18	5	1200	6	27.7	35.4
(6)t	94	1917	55,800	196.5	23.9	18	5	1200	4	28.9	37.8
u	95	1917	55,800	196.5	23.9	18	5	1200	4	29.6	32.0
v	100	1917	56,000	196.5	23.9	14	5	1200	4	30.0	40.0
w	104	1917	68,500	226.5	23.9	16	5	1200	4	28.5	52.1
(7)x	112	1918	62,200	211.5	23.9	18	7	2030	6	36.4	44.5
y	120	1919	20,000	120.8	18.7	12	4	960	6	36.8	10.0

(1) All the airship types listed were built at Friedrichshafen, except types *a* to *e*, inclusive, which were built at Manzell, type *u*, which was built at Frankfurt, and types *t* and *x*, which were built at Loewenthal.
(2) The "L Z number" is the number by which the Zeppelin works indicate a ship before its delivery. The German navy marked its Zeppelins with the letter L (*Luftschiff*), while the German army originally marked its Zeppelins with the letter Z, but later used the L Z numbers as the service mark. Beginning with L. Z. 42, however, the army Zeppelins were indicated with a number which was thirty units ahead of their factory number that is, L. Z. 42 became L. Z. 72, and so forth. This was apparently done to mislead the Allied intelligence service.
(3) L. Z. 35 of this class was the first ship to be fitted with monoplane rudder.
(4) First ship to have spur gear drive.
(5) First ship to be fitted with side cars ("power eggs").
(6) First use of twin-engined cars with single propeller.
(7) First use of direct drive propellers.

* The ship was recalled shortly before reaching its destination

be regarded only as an experimental ship. Type *c* reached 11.9 although the resistance appears to have increased. Actually, the already somewhat fattened form may have caused a decrease in the coefficient of resistance

In type *d* the aerodynamic coefficient decreases somewhat—to 10 6 or 10 6 after the installation of a more powerful engine. In type *e*, which undoubtedly had smaller parasitic resistance, it rose again to 15 5 although the form of this ship certainly was an improvement compared to type *d*.

A notable improvement occurred with type *f*. In this ship the angles in the hull form disappeared. The form was somewhat fatter, as with the same diameter it was considerably shorter. Also the control surfaces, which from this type on were fitted only at the stern, were reduced so that the aerodynamic coefficient of 23 4—in spite of the increased engine power, for which the propellers used were not suitable—is understandable.

Type *g* is only slightly better than *f* in spite of the improvements in the parasitic resistance, especially in the control surfaces. It is also somewhat more slender. Type *h* reached the value of 28.6 which, however, after the fitting of more powerful engines (from LZ-15) decreased somewhat again in spite of the shortening.

Types *i*, *k*, and *l* (including LZ-23) have low aerodynamic coefficients throughout.

Only with type *m* does the coefficient, rise again to 27 which without doubt may be attributed principally to the monoplane stabilizers, fins and rudders (from LZ-25 on). Type *n* in which for the first time a propeller with gear drive was used at the after end of the forward car, instead of side propellers, showed no aerodynamic improvement. It had a value of only 25 9—because the wash of the forward propeller swept over the midships cabin with which this ship was fitted, causing an increase in resistance. On account of the removal of the outside gangway in type *o* the aerodynamic coefficient increased to 29 7

A very notable increase from an aerodynamic point of view was obtained with type *p* which had a form entirely different from the earlier ships with a much smaller length diameter ratio. This form, based upon comprehensive studies by the author, is found in all the succeeding ships of the Zeppelin Company and makes possible the attaining of smaller hull weights together with smaller coefficients of resistance because of the increased fullness and relatively smaller surface. With a structurally similar arrangement of type *p*, compared to type *o* the aerodynamic coefficient of type *p* increases from 29 7 to 38 or about 30 per cent. With the fitting of more powerful engines and the same propellers (from LZ-48) the aerodynamic coefficient naturally decreases to 34.4, to again increase in type *q* to 35 1 on account of the continued reduction of the parasitic resistance and in spite of lengthening.

Type *r* in which a further reduction of the length-diameter ratio took place shows again an increase of the aerodynamic coefficient to 39 6. Because of the removal of the after propeller with its associated resistance, this figure increases in type *s* to 42.9 and in type *t* to 49 0, in which for the first time the side brackets on the after car were also completely removed and in their place a twin engine installation was fitted, with a single propeller. In this ship also the outer cover was for the first time applied with the divisions along the longitudinals, thereby reducing the frictional resistance, instead of with divisions along the transverses as was usual until then.

A further improvement from the aerodynamic point of view was again attained with type *u*, with a coefficient of 54.2, in which there were fitted special propellers based upon extensive studies. These propellers were in complete agreement with the engine power, revolutions and the resistance of the ship. The comparison of speeds given under 1 3a brings this out most plainly.

Type *v* gave a small increase of aerodynamic coefficient—increasing it to 56.0—which, however, after the fitting of more powerful engines with the same number of propellers and the same revolutions fell again to 54.0. Type *w*,—in which the same engine power was used as in the type *v* ships with the coefficient of 56 0,—attained however only 54.4 on account of the increase in length of this type.

A very important step in the improvement of the aerodynamic properties was made possible in type *x*, in that by the use of four direct drive propellers the resistance of the cars and their suspensions could be reduced, so that with the simultaneous increase of engine power and the consequent increase in speed an improvement of propeller efficiency occurred. The aerodynamic coefficient of 62.2 reached with this ship makes the improvement most apparent.

Type *y* (the passenger airship "Bodensee") and the latest, inspite of its small size has slightly exceeded the last ship with a coefficient of 63 7—on account of further reductions in the length-diameter ratio—and is from an aerodynamic point of view *the best ship to date*

The comparison of the figures 7.7 and 63 7 gives a correct picture of the development of the airship from an aerodynamic point of view.

If only Zeppelin airships have been discussed this far, it is because the figures computed from ships from other yards are mostly much smaller. For instance the values of $\left(\frac{\eta}{\xi}\right)$ for the other German airships reach only 40 for non-rigids, while the best English airship R-33 (and R-34) attains only about 41 as an aerodynamic coefficient.

The value $\left(\frac{\eta}{\phi}\right)$ which can be used for comparison with the analogous figure of the airplane is about 2 for type *b*, about 10 for type *x* and 28 for type *y*.

(b) The aerodynamic coefficient has not increased with the development of airplanes at the rate it has in airships. The Wright biplane of 1905 already had about 12 as $\left(\frac{\eta}{\xi}\right)$ while the airplanes of 1914 could show only from 10 to 16 for monoplanes and 12 to 20 for biplanes. To be sure the present airplanes in the case of some specially well worked out types reach 36 or 38, but 24 to 32 can still be taken as normal.

In comparison with this, however, the development is shown much more plainly by the value of $\left(\frac{\eta}{\phi}\right)$. The Wright biplane had a coefficient of hardly 1, while with modern planes a value of 5 to 8 can be obtained.

These figures also permit a comparison with the corresponding coefficient for the airship which today, as was mentioned above, already stands at 26

1 4 a. The useful load of airships shows a very remarkable increase with their development. Beginning with type *b* (compare again Table III) with 2.8 tons it reaches successively in type *h*—9 4 tons, in type *p*—16 2 tons, in type *r*—32 5 tons in type *v*—40 tons. Type *w*—the cargo airship previously mentioned—had the greatest useful load thus far, 52.1 tons.

I 4b. If the useful loads of the airplane are now compared the figures appear somewhat modest, even though their increase also has been an extraordinary one. The first Wright machine in 1903 could provide only about 70 kilograms of useful load. After many improvements the same type reached 180 kilograms in 1908. Farman in 1910 reached 220 kilograms, Breguet in the same year, 420 kilograms. In 1911 650 kilograms was reached, in 1912—1050 kilograms and in 1914—1400 kilograms. The large airplanes of today have about 2 tons useful load, the Giant airplanes—4.5 to 5 5 tons.

THE STRUCTURAL COEFFICIENT

A correct idea of this is afforded by the representation of the structural coefficient θ, the ratio of Useful Load to Weight Empty. Type *b* shows the smallest structural coefficient, which after the reconstruction was 0 25. This increased in type *c* to 0 36, in type *e* to 0 44, in type *f* to 0 51, while types *d* and *g* fell back somewhat, with 0.32 and 0 29 for *d* and 0.43 for *g*.

Type *h* reached 0 56 while type *i*, in spite of the considerable increase in volume, was relatively somewhat heavier and had a coefficient of 0.55. Type *k* of about the same size as *h* reached 0.57 while both type *l* with 0 49 and type *m* with 0.54 were somewhat poorer. Type *n* with a greater gas volume and a coefficient of 0.72 was again considerably lighter. The similar ships of type *o*, however, as a result of many additions barely reached above 0 62. A further improvement from the structural point of view brought type *p* with 0 78 while type *q*, which was a lengthened type *p*, reached only 0.76.

The most notable increase of the structural coefficient was reached by type *r* and its derivatives. These ships, of types *r* to *w*, had structural coefficients of 1.0 to 1.6 while type *w*, the largest ship so far, reached 1.6. Type *x*, in spite of a greater gas volume than *v*, had the same structural coefficient as the latter, 1.6, because it was designed for considerably greater engine power and consequently was built relatively heavier. Finally the small type *y* (about the same size as *h* which had a structural coefficient of 0 56) shows with its structural coefficient of θ = .76 the improvement from a structural point of view which has taken place since 1912.

The comparison of 0 25 type *b*, and 1 6, type *w*, summarizes the structural improvement as a whole

A comparison with the airships of other yards is also of interest here. The best of their ships barely reached a structural coefficient of θ = 1 4 for rigids in Germany, 0 6 for rigids in England 0 95 for non-rigids in France and 0 9 for non-rigids in Italy.

(c) At the beginning of their development the coefficient θ for airplanes had a value of 0 3. In 1914 the value increased until somewhat over 0 5. Today the passenger planes are of about .5 to .7. Exceptionally lightly constructed craft, especially small airplanes, attain 0 8 and more. (The 45 hp. Blackburn is said to have a coefficient of 1 21 and the 35 hp. W.K.F. 1 00

As far as can be learned from credible information no type of very large or Giant airplane exceeds θ = 0 65

THE FIGURE OF MERIT

(a) The values of the "Figure of Merit" λ obtained from the product of the aerodynamic coefficient and the structural coefficient will be given in condensed form

If we begin with type *b*, which after the reconstruction had a value of λ = 1.6, the most important types show the following increases; type *c*—4 3, *e*—6 8, *f*—12.0, *h*—14.4, *m*—14.7, *n*—18.8. Then follow the important types *p* with 29.5 and *r* with 40 7, *s* with 55.7, *t* with 68.4, *u* with 81 6, *v* with 89 4 and *w* with 103

This increase in the value of the figure of merit from 1.9 to 103 portrays the whole development of the Zeppelin airship from a technical point of view

As neither the aerodynamic coefficients nor structural coefficients of the ships of other airship plants reached the values of those of the Zeppelin airships, a consideration of the figure of merit of these other ships is unnecessary. Their best stands at between 30 and 60 per cent of the best value of λ of the Zeppelin airships.

The fall of the value to 100·0 in type *x* is to be attributed to the greater weight of the propelling machinery. Type *y* finally shows a figure of merit of only 48.2 because it again is much smaller, and smaller ships of the same speed must be relatively heavier than larger ones

If one writes $\lambda' = \left(\frac{\eta}{\psi}\right)\theta$

then for type *w* $\lambda' = 49.3$

(b) In comparison, airplanes in the beginning stood at about λ = 3 6 and now are between 25 and 45. λ' now, however is 10 at most, which is about 1/5 of the corresponding value for airships

THE ECONOMIC COEFFICIENT

(II a) As an indication of the development from an economical point of view the economic coefficient ω was derived. It should suffice if the ship and airplane types of the lowest stage of development and some of the highest stage—from a technical point of view—are selected for determining the values of this coefficient.

For the purpose of comparison a head wind of—20 km/hr will be assumed for *W* in eq. (29) and (30), for in fairness the necessity of making a profit in such common head winds must be taken into account.

The type *b* Zeppelin airship has a value of ω = 0.2, that is its income lacks 80 per cent of covering its operating costs. Consequently it would be impossible to make profit with this type if it were built and operated today. But the type *o*, the Deutschland, would also come off badly today even with the twelve hour voyage at full capacity which was assumed. It only attains ω = 0.96. Even the next to the last Delag ship, type *h*, the Sachsen, would have today, with ω = 1.37, an notable profitableness, since this value would quickly fall below 1 0 with shorter daily trips at not quite full capacity. The Bodensee—type *y*—is considerably better off with ω = 1.65, even though, with a daily voyage of only six hours—which, since the Delag at present has only one ship in service, is actually the case—ω falls to about 1.6. The largest type *x*, with ω = 5.15 is much better, but the best so far is the cargo ship, type *w*, with ω = 75.

11 b. No airplane service today can reach similar figures at the same rates.

The economic coefficients which can be computed from the published airplane data, lie always in the neighborhood of 1, and exceed 1 only in very rare instances—in which the data usually is improbable.

Conclusions as to the Further Development of Aircraft

From the figures which have been given it is evident that with increasing size of airships all of the coefficients increase—or at least do not decrease.

The following reasoning gives a further analysis. The lift increases as the third power of the linear dimension. The hull weights increase as some power less than the third since they depend partly on the volume, partly on the surface and partly on the transverse section. The power plant weights for the same speed increase as about the second power of the linear dimension since they depend on the resistance. Consequently there results an increase of the useful load as some power materially greater than the third.

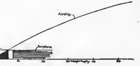


FIG. 3 ECONOMY COEFFICIENTS FOR AIRSHIPS AND AIRPLANES OF 130 KM./HR. SPEED REFERRED TO WEIGHT EMPTY

Apparently there is no upper limit to the increase in size of the airship. To be sure, landings will be more difficult with ships of larger size; but the problem doubtless lies within the range of a technical solution even for ships of very great size. The handling and operation of the ship in the air are easier the greater its dimensions, since the movements of the larger ship are slower.

The dependence of economy on the increase of size has been plainly shown by the reasoning above. The curve ω of Fig 3 shows this very notable increase of the economy in relation to the weight empty. It will be seen that the Profitableness under the assumed conditions begins to be positive at a weight empty of about 6 tons (that is about 8500 cu. m. volume) at 12.4 tons empty (that is at 20,000 cu. m. volume) it reaches 100 per cent and before 100,000 cu. m. volume it reaches 500 per cent.

The circumstances are entirely different with the airplane. At first sight and in view of the figures which have been given it seems that an improvement is possible with increase in size. This impression corresponds to the facts. If a train of reasoning similar to the one given above is followed there results for the airplane lift an approximately quadratic relationship to the linear dimension if equal speed and consequently approximately equal unit load on the surface is assumed. Airplane wing weights for geometrically similar planes of larger size and the same factor of safety would increase as the third power of the linear dimension. It is however practicable—as is explained in another place—to get off with an increase as the second power. (See Everling. "Increasing the size of the Airplane" Technische Berichte II

and III). Considering the nearest possible equal factors of safety 2.2 should be taken as the exponent for passenger carrying planes.

The body, landing gear and rudder weights likewise increase at a rate somewhat higher than as the square, but less than the wings. The power plant weights for the same speed would increase exactly as the second power if the unit weights of engines, radiators, piping and controls remained the same as the plane increased in size. Since, however, according to experience thus far, increasing unit weights must be assumed, the power plant weight goes up faster than as the second power. There consequently remains for the useful load an increase at a rate considerably less than the second power.

It must be admitted that plainly marked upper limit to the airplane is not fixed, although it can already be perceived that the increase in size can result in no improvement. But the landing difficulties increase with increase in the size of the airplane. These may be combated, but it is hardly likely they will be conquered—which may be assumed as certain in the case of the airship with its landing speed of about zero. The landing and operation of the plane in the air will probably be more difficult with increase of size, on account of the greater forces involved in disturbances of stability, and in no case easier.

It is the degree of profitableness which sets a limit to the increase in size. With planes constructed as at present this lies far below the most recent sizes. The curve of the economic coefficient as plotted above the weight empty—as shown in Fig. 9—rises rapidly at first reaching l, under the conditions assumed with a plane of very small size. It exceeds l only a little, reaching its maximum of 1.33 at about 12 tons weight empty (corresponding to about 58 sq. m. plans area, 180 hp., 900 kg. useful load, that is, pilot and five or six passengers, for a trip about 1200 km) and from there sinks again below l.

If the two curves are and are compared the monopoly of aerial navigation by the airship, from the standpoint of technical perfection, is beyond doubt with the exception of the important difference noted above.

There is an upper limit to the upward development of the airplane, although it is of course still capable of very material improvement. There is none for the airship. The airplane designer to be sure knows of no limit. It is possible for him to design and build airplanes of 20,000 hp. Time will tell if it is worth while, provided the business man does not interpose his authority.

A great task still awaits the airship designer. For, as it increases in size, the airship will become more efficient than it has been attempted to show here, if it is further improved and perfected. The lines along which this should proceed are known.

Summary

On the basis of the general relations for the condition of equilibrium coefficients are derived to characterize the development of aircraft from a technical point of view. Numerical values are obtained for these from a copious supply of data. In this there are distinguished in the separate investigation of airship and airplane.

(1) An aerodynamic coefficient = $\dfrac{\text{Propulsive Efficiency}}{\text{Coeff. of Resistance}}$

(2) A structural coefficient = $\dfrac{\text{Useful Load}}{\text{Weight Empty}}$

(3) A Figure of Merit = the product of the other two.

To indicate the development from an economic standpoint, authentic figures based on definite assumptions are derived from the estimation of profitableness, which condensed to simple formulas are finally expressed in an economic coefficient in absolute units.

From the computed values, which are reproduced in the form of curves, conclusions are drawn as to the further development of aircraft which show a considerable superiority for the airship even in smaller sizes—which increases in the larger sizes—and which destroy the exaggerated hopes, which so many persons have trumpeted to the world, of the giant airplane as the method of transport of the future.

Even though the figures and limits assumed in this work change and shift somewhat in the course of time, and in the place of this or that something different can be substituted, in magnitude of economy only the small airplane will remain a real competitor of the—small airship. Against the large airship no airplane can compete, least of all the giant airplane.

Protecting the Public

The following is a reproduction of a warning notice issued by the British Air Ministry and which is displayed on and in the neighborhood of aerodromes in Great Britain.

WARNING TO THE PUBLIC

IN REGARD TO

AIRCRAFT

WHEN AN AEROPLANE IS ON THE GROUND

DON'T crowd round the machine—the pilot must see what he is doing.

DON'T touch any part of the aeroplane, or you may endanger the pilot's life. Do what he asks you at once.

DON'T smoke or throw lighted matches within 20 yards of the machine: there may be dangerous petrol fumes about.

WHEN AN AEROPLANE IS LANDING OR RISING

DON'T run to where you think it will land. Keep out of the way, near a hedge or other obstacle, and wait until it stops.

DON'T stand in the direct run of an aeroplane which is about to rise.

DON'T let children or animals stray in the route of a landing or rising aeroplane.

IN CASE OF ACCIDENT

Beware of fire.

If occupants are injured, get them out at once as gently as possible.

Telephone or send for doctor and ambulance. Do not give spirits.

Telephone or send to nearest aerodrome, giving number of machine and position of accident.

If the machine is burning, try and subdue flames with sand, earth, wet sacking, etc.; or fire extinguisher if available.

Leave someone to guard the machine, if possible, and inform police.

A. S. Mechanics School Transferred

The Air Service Mechanics School at Kelly Field, Tex., was recently transferred to Chanute Field, Rantoul, Ill. The move was commenced on Jan. 27, and was completed on Feb. 25, with the arrival of Major Stratemeyer, the new commander of Chanute Field. It took ninety cars, a train just a mile long, to move the entire equipment of the school to its new quarters.

Flying has been carried on since Feb 1 at this field conditions in the locality being very favorable for any kind of flying.

W. H. C. Aircraft Corp.

The W. H. C. Aircraft Corp., Inc., of 12 West 34, Lynn, Mass., a new firm capitalized at $25,000, reports increased aviation activity in that section and promises to have a very busy year. The firm is headed by W. S. Walker, as president, a former Government Aircraft Inspector, and by Lt. Charles M. Cummings, a former U. S. Army pilot, as Secretary and Sales Manager.

The factory of the new company is conveniently located near a natural flying field and also near the bay of Point of Pines, which makes it a good sea-air port for local fliers.

"Who's Who in American Aeronautics"

Elbert John Hall

HALL, ELBERT JOHN Aeronautical Engine designer; born, San Jose, Calif. April 30 1882, son of William Henry Hall and Mary E. (Henning) Hall; married, Carolian B. Smith March 11, 1906.

Educated: Oak Grove Grammar School, San Jose, Calif.; California Grammar School Pan Robles, Calif; San Jose High School San Jose, Calif.

Professional: Started in 1899 in San Francisco to repair, design and build, gasoline engines also doing all kinds of jobbing work in connection with machinery; designed an automobile complete for the Heine-Velox Co. of San Francisco and built several in 1905; designed an automobile for the Sunset Auto Co. in 1907 and formed the Hall-Scott Motor Car Co. in 1910 to Manufacture railway motor cars and aviation engines.

Aeronautical Activities: Designed and built 8 cyl. 60 HP aviation engine in 1909 weight, 210 lb. V type used by several aviators successfully. Brought out several four and six cylinder vertical models in next few years; designed and built the A 5 and A 7 engines in 1914 1916 being 6 and 4 cylinder, 125 and 90 HP, respectively large quantities being sold government for military purposes; built A5a and A7a engines 150 and 100HP, for our government, in 1916-1917; assisted in design and production of Liberty 12 aircraft engine and DH-4, and Bristol planes for Army in 1917 1918; as Lt. Col. Air Service, Head of technical Dept. air Service, A. E. F. in Oct. Nov. Dec. 1918; 1919-1920, building stock aviation engines known as L-6 and L-4, 200 and 125 HP 6 and 4 cylinder 5"x7" stroke.

War Service: Major Signal Corps, Oct. 1917; Lt. Col Air Service, May 1918; discharged Dec 1918.

War Honors: Awarded distinguished Service Medal for work on Liberty 12 and LeRhone airplane engines; also for work on DeHaviland 4 airplane production and engineering; handling all technical and engineering and design work for A. E. F. Technical Section Air Service.

Member: Society Automotive Engineers.

Present Occupation: Vice-President and Factory manager of Hall-Scott Motor Car Co.

Address: 9th and Snyder, Berkeley, Calif.; home 199 Lafayette Ave., Piedmont, Calif.

Gerald Evans Brower

BROWER, GERALD EVANS, Captain U. S. Air Service; born Brooklyn, N. Y. Aug 25 1890; son of Daniel K. Brower and Mary Evans Brower; married Melissa D. Hoffman, June 20 1917.

Educated: Public School No. 139 Brooklyn, N. Y. Boys High School, Brooklyn, N. Y.; C. E. 1910 Cornell University.

Professional: Thomas Bros. Aeroplane Co., 1914 1915. Entered U. S. Army (Field Artillery) Nov 1916. Served in Air Service, Oct 1919 to Feb 1920. July 1920 to present, as Observer, Pilot Operations Officer, Group Commander, Adjutant, etc.

Aeronautical Activities: Thomas Bros. Aero Co. 1914 1919. Engineer in charge of School U. S. Air Service; Observer Pilot, Operations Officer Group Commander, School Adjutant successively from Oct 1918 to present.

Flying Rating: Aerial Observer, Feb. 11, 1919. Reserve Military Aviator, July 9, 1919.

War Service: Field Artillery to Oct. 1918, Air Service Oct 1918 to end.

Member: Aero Clubs at High School and Cornell University.

Present Occupation: Adjutant, Field Officers School.

Address: Langley Field, Va.

George Howard Brett

BRETT, GEORGE HOWARD, Major, Air Service; born, Cleveland, Ohio, Feb 7 1886, son of William Howard Brett and Alice (Allen) Brett. Married Mary Devol March 1, 1919.

Educated: Grammar and High Schools of Cleveland O. Virginia Military Institute.

Professional: 2d Lt., Philippine Scouts March 1910 to Aug 1911. 2d Lt., Cavalry, Aug 1911 to Oct. 1915.

Aeronautical Activities: Detailed in Aviation Section Signal Corps, Oct 1915. Qualified Junior Military Aviator, Sept. 2, 1919. Qualified Military Aviator Sept. 2 1919.

Flying Rating: Airplane Pilot.

War Service: Served as Major Air Service, throughout war. Thirteen months in France.

Present Occupation: Property Division, Supply Group, Air Service.

Address: Care of Office Chief of Air Service, Washington D. C.; home, 19 Hesketh St., Chevy Chase, Md.

Frank P. Lahm

LAHM, FRANK P. Major, Air Service; born, Mansfield, Ohio, Nov 17, 1877; married, Gertrude Jenner, Oct. 19, 1911.

Educated: Public Schools, Mansfield, Ohio, U. S. Military Academy.

Professional: Army Officer all grades to Colonel.

Aeronautical Activities: France Sept. 20 to Oct 1, 1906, winner 1st Gordon Bennett Balloon Race, Paris. In charge Wright tests, Ft. Myer, Va, 1909, 1909 winner National Balloon Race, St. Louis, July 1911. Organized Army Air Service in Philippine Islands 1912.

Flying Rating: Military Aviator (War Dept.) Aero Club of America, License, No. 2 Spherical Balloon Pilot, License No. 2, Dirigible Balloon Pilot, Aviator's Certificate, No 2, Expert Aviator's Certificate No 15.

War Service: Oct 1913 to Apr 1919 Commanded Air Service 2nd Army A. E. F.; On Staff of 1st Army, A. E. F., July 26, 1919 to Oct 12 1919.

Member: Honorary Member, Aero Club of America, Life Member, Aero Club de France.

Present Occupation: Air Service Representative, General Staff Corps.

Address: Air Service, Washington, D. C.; home, 1829 23d St. N. W. Washington, D. C.

James Floyd Smith

SMITH, JAMES FLOYD Aeronautical Expert; born Genesee Ill., Oct 17, 1884, son of John F. Smith and Kate J. Smith; married, Hilder F. Youngberg May 11 1907.

Educated: Public Schools, Union Ore. and San Diego, Calif.

Professional: 1895-1900 and 1902, circus rider 1903 Machine shop 1904 Gas Motor Engineer 1906-1910 Aerial Gymnast 1910-1911 Orange Ranch, 1919, built tractor biplane and flew June 1st.

Aeronautical Activities: Jan 15, 1912 to June 1 1912 Constructed Airplane. On 9th day of practice, flew cross country with passenger 1 hr 7 min. Fall 1912 flew Bleriot II wife and I did parachute jumps from planes 1914. Looped Martin T plane, June 1914 wing collapsed on loop 1914 landed O. K. June 1916 landed plane safely 50 ft in front of wall with passenger and ... primed bombs at Aguas Calientes Mexico, made 9 altitude records with seaplane in 1918. Constructed free type manually operated life pack in 1919. Proved it by a jump, May 14 1919. Patents—Hydro-aeroplane adjustable step 1919, two aerial bombs 1917 landing set 1917 life pack 1919 helicopter 1920 Nov 21 1919 did parachute jump from plane at 120 m. p. h. and 75 ft altitude at Anacostia.

Present Occupation: Manufacturing life packs, aeronautical development.

Address: 987 W. Adams St., Chicago, Ill.; home, 4053½ Sheridan Road Chicago Ill.

Theodore Gordon Ellyson

ELLYSON, THEODORE GORDON Commander U. S. Navy, born, Richmond Va. Feb 27, 1885 son of Henry Theodore Ellyson and Lizzie (Walker) Ellyson; married Helen Mildred Lewis Glenn Nov 10, 1910.

Educated: McGuire's School, Richmond, Va.; U. S. Naval Academy.

Professional: Graduated Jan 29, 1905, duty in battleships, Atlantic Coast and Asiatic station until Nov 1908 in command of gunboats Asiatic Station until Nov 1909 in command of submarines until Dec 1910. Began U. S. Naval Aviation and in command of Operations until June 1913. Battleship duty to July 1919, Instructor Naval Academy to Feb 1919. Plymouth Eng to April 1919 with Submarine Chasers. Destroyer command to Jan 1921. Present, Executive of Air Station Hampton Roads, Va.

Aeronautical Activities: Development of Naval Aviation from 1910 to 1919 including development of first hydro-aeroplane with Glenn H. Curtiss and Navy Compressed Air launching device. First Naval officer to be trained in flying, was one of the first Navy flyers to take part in fleet maneuvers at Guantanamo in 1913 which is considered the start of Naval Aviation.

Flying Rating: Aero Club of America, Aviators license No 28. Aero Club of America, Military Aviator; Navy Department, Naval Aviator No 1.

War Service: Plymouth, England with Submarine Chasers.

War Honors: U. S. Navy Cross.

Member: Army and Navy Club (Wash.)

Present Occupation: Executive Officer, Naval Air Station, Hampton Roads, Va.

Address: Naval Air Station, Hampton Roads, Va.

Frank M. Kennedy

KENNEDY, FRANK M., Major, Air Service, born, Chicago Ill. July 10 1888, son of Craige O. Kennedy and Della L. Kennedy; married Leslie Pyrl Nelson Sept 22 1911.

Educated: Schools of Hinckley Ill. high school graduate; B. S. O. B. 1909 University of Wisconsin.

Professional: Army officer from Sept 1909, entered army immediately after leaving college, Sept. 1909 2d Lieut. 10th Infantry, June 1916 1st Lieut. 10th Infantry; May 15, 1917 Capt. Infantry and Signal Corps; July 1st 1920, Major Air Service.

Aeronautical Activities: U. S. Army Aviation school College Park, Md. Aug 1911 to Oct. 1912, Balloon school Fort Omaha, Nebr. as student officer July 1917 to Oct. 1917 qualifying among the first 100 free balloon officers as observers and qualified over 700 officers at Omaha. July 1918 to Jan. 1919 in charge of all balloon observation work at Post Field in connection with the training of officers at Artillery school of Fire at Fort Sill, Okla. Jan 1919 to May, training as airship pilot at Naval School at Navy Yard Pensacola, Fla. graduating May 11. On duty at Washington D. C., May 10 1919 to date in charge of all lighter-than air Engineering and experimental work.

Flying Rating: Free Balloon Pilot Airplane pilot License No. 97 Airship pilot Balloon Observer.

War Service: Sept 1908 2d Lieut. 10th Infantry, June 1916 1st Lieut 10th Infantry; May 15 1917 Capt Infantry and Signal Corps, July 1st 1920 Major Air Service.

Member: Army and Navy Club (Wash.)

Present Occupation: In charge of all lighter-than air Engineering, Air Service.

Address: Munitions Bldg., Washington, D. C.; home Hinckley Ill.

Hubert Reilly Harmon

HARMON, HUBERT REILLY Major, Air Service; born, Chester Pa., April 3 1892, son of Millard F. Harmon and Madelin (Kendig) Harmon.

Educated: Public school 102 Brooklyn, N. Y., 9 years; Boys High School, Brooklyn N. Y. 1 year; Polytechnic Preparatory School Brooklyn, N. Y., 2½ years; U. S. Military Academy, West Point N. Y. Graduated 1915.

Aeronautical Activities: Went to Army flying school at San Diego, Calif., on Dec. 9, 1915, has been in army Air Service ever since.

Flying Rating: Pilot's license, March 1917, Aero Club of America; Junior Military Aviator, U. S. Army June 20, 1917; Airplane pilot, U. S. Army.

War Service: Aeronautical officer, Southern Department, San Antonio, Texas, and Air Service examining Board May 1, 1917 to Jan. 4, 1918. Engineer Officer Kelly Field Texas Jan 4, 1918 to March 4 1918. Officer in charge of flying, Barron Field Texas, March 5, 1918 to Sept. 3, 1918; Pursuit School France Oct 29, 1918 to Jan 5, 1919; Chief of Staff Air Service 3d American Army Headquarters, Coblenz, Germany, Jan. 5, 1919 to Sept 29 1919.

Present Occupation: Assistant Executive, Office Chief of Air Service, War Dept., Washington, D. C.

Address: Assistant Executive, Office Chief of Air Service, War Dept., Washington D. C.; home, Army and Navy Club, Washington, D. C.

Philip J. Roosevelt

ROOSEVELT, PHILIP J., investments, born, New York City, May 15 1892, son of W. Emlen Roosevelt and Christine (Kean) Roosevelt; unmarried.

Educated: St. Mark's School, Southboro Mass.; A. B. 1913 Harvard.

Professional: New York Globe 1913-1916; Aviation and Aeronautical Engineering, 1916-1917; War 1917 1919; Banker Roosevelt and Son 1919.

Aeronautical Activities: 1st Aero Co. N. Y. N. G. 1915-16; Editor Aviation and Aeronautical Engineering 1916; Commissioned Air Service 1st Lt. May 1917, Captain Aug. 1917, Major, Feb 1919.

War Service: Overseas Oct 1917 March 1919, Operations Officer 1st Pursuit Group; Operations Officer 1st Pursuit Wing Air Service.

War Honors: Croix de Guerre with palm, Citation G. H. Q., A. E. F. also Headquarters Army Group A. E. F.

Member: Aero Club of America (Governor), Harvard Club.

Present Occupation: With Roosevelt and Son, investments.

Address: 30 Pine St., New York, home, 804 Fifth Ave., New York.

George Eustace Amyot Hallett

HALLETT, GEORGE EUSTACE AMYOT Captain Air Service born, Cheltenham, England, May 9 1889 son of M J Hallett and A. C Hallett married, Grace A Wixom, Sept. 08 1919

Educated California public schools, Correspondence Courses (I C S) Continuous home study

Professional Served apprenticeship as Machinist San Diego, Calif, Foreman of shop and gas engine expert, 1909-1910 with Curtiss Aero & Motor Corporation 1911-1914 as plane and engine mechanic and later an engineering expert Travelled through Russia, Germany and France for Curtiss Company in 1911 and 1912

Aeronautical Activities American Pilot on Wanamaker-Curtiss Trans-Atlantic Airplane 'America' in 1914 Civilian Aeronautical Mechanical Engineer with U S. Air Service 1919-1918 Major Air Service 1918-1920 Organized all Air Service Mechanics Schools during War in charge Power Plant Section of Engineering Division Air Service 1918 to date Member National Advisory Committee for Aeronautics, and Army and Navy Aeronautical Board

Flying Rating Reserve Military Aviator

War Service Commissioned Major, Air Service from Civil Service May 18, 1918 Demoted to rank of Captain, due to lack of age in Army reorganization July 1920

Books Airplane Motors (Confidential Signal Corps publication) used during War as text book

Member Society of Automotive Engineers Aero Club of America.

Present Occupation: Chief of Power Plant Section Engineering Division, McCook Field.

Address McCook Field Dayton O home 870 Delaware Ave Dayton O

Rudolph William Schroeder

SCHROEDER RUDOLPH WILLIAM Automotive business born Chicago, Ill. Aug 14 1885 son of John Schroeder and Anna (Reidy) Schroeder

Educated Grammar High and Normal Schools also Crane Technical School, all of Chicago Ill

Professional Started in Automobile business in 1900

Aeronautical Activities Built gliders 1908 to 1910 Airplane Mechanician to Otto Brodie (Farman) learned to fly under him 1910 1911 Mechanician to Beachy, Jimmie Ward Katherine Stinson Mickey McGuire, Max Lillie De Loyd Thompson and others. World's Altitude Record, Sept 18 1918 28,900 ft Won first place in the Handicap Event, of the New York-Toronto Race, in Aug 1919 Two Man World's Altitude Record 32,500 ft., Jan 19 1920 One Man Altitude, World's Record 38,180 ft., Feb 27 1920 U S. Air Service Pilot in the Gordon Bennett Sept 1920

Flying Rating: R M A Enlisted Aviation Section Oct. 1916 Chief test pilot 1919 1920

War Service Major, U S. Air Service, Test Pilot Air Service Engineering Dept.

Member Aero Club of America Aero Club of Illinois Aero Club of Kansas

Present Occupation Aeronautical equipment

Address 2240 Diversey Boulevard Chicago Ill., home 2278 Logan Boulevard, Chicago, Ill.

Thomas Henri Huff

HUFF THOMAS HENRI Aeronautical Engineer born Glassboro N J June 22, 1892 son of Henri M O Huff and Mary R Huff married, Aline Laan Nov 17 1917

Educated Episcopal Academy Philadelphia, Pa, University of Pennsylvania, S B, Massachusetts Institute of Technology

Professional Sturtevant Aero Co 1916 Instructor Massachusetts Institute of Technology 1915-16-17 Standard Aero Corp 1917 18 19, Naval Aircraft Factory 1919-20, Huff Daland and Co 1920 21

Aeronautical Activities Design and Construction of airplanes and seaplanes since 1917

Present Occupation President of Huff, Daland & Co

Address Adams Ave., Ogdensburg, N Y, home, 4 Greene St., Ogdensburg, N Y

Albert Palmer Loening

LOENING ALBERT PALMER Airplane Constructor born, New York City, Aug 31 1886, son of Albert Loening and Hermine R Loening

Educated Cutler School, New York Lawrence School Lawrenceville N J

Aeronautical Activities Chairman Committee on Amalgamation American Flying Club

War Service Mexican Border Service with 7th New York Infantry Captain Air Service June 1917 promoted to Major, Jan 1919, Served with A E F

Member Aero Club of America, Army and Navy Club (Wash) American Legion Sons of American Revolution

Present Occupation Vice-President and Treasurer, Loening Aeronautical Engineering Corp.

Address 351 West 52 Street, New York City Home, 116 East 63rd Street, New York City

John Preston Tarbox

TARBOX, JOHN PRESTON Aeronautical Engineer born Georgetown S. C., Dec. 14, 1884 son of Frank Green Tarbox and Mattie Florence Tarbox. Married, Mary Kolbe, Nov. 24, 1908

Educated Winyah Graded School, Georgetown, S. C. Clemson Agricultural College, S. C. National University, Washington, D. C. George Washington University, Washington D C B S, LL B, and M P L (Master patent Law)

Professional Assistant Cashier Clerk, Millwright Electrician; Assistant Consulting Engineer Electrical Engineer Patent Attorney. Member bar, D. C., District Court and U. S. State

Aeronautical Activities 1911 1911 formed Tarbox Safety Aircraft Co. 1913 to date the following connections with the Curtiss Aeroplane and Motor organizations; 1913-1919 Patent Counsel, 1916-1919 Aeronautical Engineer, 1919 Director Research Department, 1917 and 1919 Member Board of Directors, Manufacturers Aircraft Ass'n, 1917 to date, Chairman Patents Committee, M. A. A. 1919 to date Assistant to Mr Glenn H Curtiss Secretary Curtiss Engineering Corporation

War Service With Curtiss Aeroplane & Motor Corporation

Member American Patent law Association Society Automotive Engineers.

Present Occupation Assistant, Mr Glenn H Curtiss

Address Care of Curtiss Aeroplane & Motor Corp Garden City N Y home 64 Brook St. Garden City, N Y

Damon E. Cummings

CUMMINGS DAMON E Commander U S Navy born at Chenoa Minn April 16, 1885 son of Rev Chas. A Cummings and Ada F Cummings married Frankie F Morris, April 17, 1906

Educated Local Grammar and High Schools at Chicago and Belleview, Ill 1907 U S Naval Academy Graduate Naval War College, Nov 26, 1920

Professional Appointed to U S Naval Academy 25 May 1905 from Illinois

Aeronautical Activities Executive officer of U S S Shawmut first U S Naval Aircraft tender Jan 1919 to Nov 1919 Experimental work with development of bombing Command of Naval air Station Rockaway Beach, L I N Y from Nov 22, 1920

War Service Officer U S. Navy since May 25 1905

War Honors Navy Cross for service as executive officer U S S Shawmut, laying Northern Mine Barrage in World War. Commander Aviz (Portuguese) for service in connection with first Transatlantic flight (NC-4) May 1919

Member Naval History Society

Present Occupation Commanding officer Naval Air Station Rockaway Beach, N Y

Address Naval Air Station Rockaway Beach L I, N Y

John Herbert Jones

JONES, JOHN HERBERT Captain Air Service born Andalusia Ala July 5 1888 son of Morgan D Jones and Mattie M Jones married Nellie A Lockard Aug 28 1917

Educated Local Grammar; Dadeville and Florala, Ala University of Alabama 1909 to 1912

Professional Former Plant work Meridian Highf and Co Meridian Miss from April 1914 to Sept 1915 Enlisted A S S C Regular Army Oct 1916 Stanford Calif Commissioned, Provisional 2d Lt Infantry March 19 1917

Aeronautical Activities Ground School Austin Tex Class 32 Flying Training San Antonio Tex April 1918 Qualified R M A July 1 1918 Engineer Officer Rockwell Field Feb to May 1919 Liberty Motor Course, Detroit, Mich., Sept and Oct 1919

Flying Rating Airplane Pilot

War Service Overseas with M T C July 1919

Member Aero Club of America; Rotary Club

Present Occupation Captain Air Service, U S Army

Address Selfridge field, Mt Clemens, Mich., home, 1506 25th Ave Meridian Miss

Otto Praeger

PRAEGER, OTTO Airplane Expert born Victoria, Texas, Feb 27 1871 son of Herman Praeger and Louisa (Stroblag) Praeger married Annie C Hardesty, Feb 27, 1897

Educated Public Schools, San Antonio Texas University of Texas

Professional 1893 1914 Newspaper Reporter City Editor, News Editor and Washington Correspondent Postmaster Washington April 1 1912 to Sept 1 1915 Second Assistant Postmaster General, Sept 1 1915 to March 1921

Aeronautical Activities In charge of Air Mail Service May 15, 1918 to March 1921

Present Occupation Commercial Aeronautics General

Address 3062 Grand Central Terminal New York

Leslie MacDill

MACDILL, LESLIE, Major Air Service born, Monmouth, Ill., Feb. 18, 1889, son of Edgar MacDill D D and Leslie (Black) MacDill

Educated Public Schools, Xenia Ohio and Madison Ind, Hanover (Ind.) College Indiana University, Massachusetts Institute of Technology A B 1909 A M 1911

Professional: Officer in U S. Army since 1912.

Aeronautical Activities Aviation Student 1914-1915 First Aero Squadron 1915-1916 Second Aero Squadron 1916-1917 Staff Chief Air Service, A E F 1917-1918 Commanding Officer Aerial Gunnery School at St Jean-de Monts, France May 1918-Feb 1919 Staff director Air Service U S Army 1919 1920 Chief of Operations Advisory Board

Flying Rating Student Airplane design M. I. T 1921 1922 Junior Military Aviator, 1918; Military Aviator 1918 Airplane Pilot 1920

War Service 2d Lieut Coast Artillery Corps 1912 1914 Aviation Section, Signal Corps 1914-1915 First Lieut A. S S C 1915 1916 Capt. A S S C 1916-1917 Major A S S C 1917 1918 Lt Col Air Service 1918-1920 Major Air Service 1920

Present Occupation On Duty, Nat'l Inst. of Tech Cambridge Mass

Address 341 Commonwealth Ave Boston, Mass Air Service Washington D C

William Carrington Sherman

SHERMAN WILLIAM CARRINGTON Major, Air Service born Augusta Ga May 5 1888 son of Albert G Sherman and Annie Lee (Hood) Sherman

Educated Richmond Academy, University of Georgia U S Military Academy

Professional: Graduated U S M A 1910; Army Officer to present time

Aeronautical Activities Learned to fly Wright plane 1912 received pilot's license June 1912 detailed in flying Oct 1912 to Oct. 1913 Chief of Staff 1st Army Air Service Oct 1918 Chief of Air Service Training March 1919-June 1920 Ass't Chief Training and Operations Group June 1920 to present date

Flying Rating Junior Military Aviator, April 1920; Airplane Pilot

War Service A E F 1st Div June 1917 to July 1918 as A D C to Commanding General and Ass't Chief of Staff 3d Corps from July 1918 to Oct 1918 as Asst. Chief of Staff Chief of Staff 1st Army Air Service, Oct 1918 to end of war

Member Aero Club (N Y) Army and Navy Club (Wash) Chevy Chase (Wash.)

Present Occupation Field Officer's School, Langley Field, Va

Address Air Service, Washington, D C., home, Augusta, Ga

Herbert Arthur Dargue

DARGUE HERBERT ARTHUR Major Air Service born Brooklyn N Y, Nov 17 1886 son of Arthur P Dargue and Madeline (Newins) Dargue married Marie Schnan Nov 17 1915.

Educated No 3 Brooklyn Public School Boys High School Brooklyn N Y, Brooklyn High School Houston N J U S Military Academy

Professional Army officer since June 13 1911

Aeronautical Activities Began flying March 3 1913, Expedition into Mexico March 17 1916 to May 4, 1916 Chief of Training at San Diego, Calif July 1916 Commandant Observation School Fort Sill, Okla., March 1918 Special Mission overseas Aug 1918 Depot A S Officer S F Dept, July 1919 Course in Aeronautical Engineering, Jan 1920 Office Chief of Air Service Sept 1920

Flying Rating Military Aviator July 1913

War Service Special Mission Overseas Aug. Sept and Oct 1918

Member Air Service Association

Present Occupation Advisory Board Office of Chief of Air Service

Address Air Service Washington, D C., home Allendale, N J

Maurice G. Cleary

CLEARY MAURICE G., Directing Governor, Aero Club of America, born Everett, Wash., 1895 son of Garrett Cleary and T C (Dheay) Cleary

Educated Andover Academy, Yale University, Ph B University of Wisconsin

Aeronautical Activities Graduate of all U S. Air Service Schools Commanding following organizations 862 Aero Squadron, 48 Aero Squadron Mitchell Field Adjutant Supervisors Branch, Washington D C Adjutant Air Service Activities Long Island 1919

Flying Rating R. M. A.

War Service April 1917 to Oct. 1919 Capt. A S A Major U S Reserve Corps.

Member: Aero Club of America Aero Club of Northwest A. S. S A

Present Occupation Directing Governor Aero Club of America.

Address: 11 East 99th St New York home, 3392 Grand Ave., Everett, Washington

Who Owns the Air?

By M. W. Royse

Aerial traffic with its ever-widening spheres of activity is innocently laying the foundation for an intricate international entanglement. The problem of air sovereignty, with its diverse interpretations, threatens to embroil the nations of the world in a long series of controversies. The problem dates back from the time of the first successful flight of a balloon, but its solution is still a thing of the vague future. It is still a matter of conjecture whether a sovereign state can control the air-space over its domains, regardless of height—whether England can govern an air-level five miles above her territory, and to what extent she can interfere with international traffic at that level?

The French government proposes to establish an aerial service between France and Poland. Conditions are ripe for such traffic, both Poland and France will greatly benefit from the ensuing intercourse. Aerial service will bring Poland within six hours of the French Rhine. There is but one obstacle—Germany Geographically, and politically, Germany lies between France and Poland. According to writers supporting the sovereignty theory, Germany should be allowed supreme authority over all activities in the air-space covering her domains Should this theory be accepted, the proposed French Polish air service will never materialize Germany will see to it that no aerial traffic, innocent or otherwise, crosses her boundaries.

The legal aspects of aeronautics have long been the subject of discussion by foreign writers. Perhaps the first decision on aerial navigation was made by Bismarck. During the siege of Paris in 1870, the French successfully used balloons to bear dispatches and literature. This led Bismarck to consider all aeronauts as spies Bismarck's act was nothing less than cowardly vengeance on a resourceful foe, another species of Prussian retaliation, but unfortunately Bismarck's word was law International conferences later changed this ruling In the Brussels Conference, and in both of the Hague Conferences, rulings were made that aeronauts bearing dispatches were not subject to the charge of espionage.

The early conferences on aerial law were mostly concerned with the international aspects of aerial navigation. Freedom of the air, and the sovereignty of the state were irreconcilable, and their respective sponsors were directly opposed to each other. The sovereignty theory granted the state all the rights that sovereignty implies—that is, absolute sway over the entire air space over the land, reaching up to the heavens. The freedom theory gave the state little, or no rights over its air-space The writers supporting the sovereign theory insisted that the sovereign state must have supreme authority over all activities in its air-space It must have the power to protect itself from attacks by air The free air supporters hoped that the air might be left free without restrictions—"a glorious domain unfettered with human restrictions"

The "Freedom of the Air"

Count Zeppelin believed in the freedom of the air He said "Since fences high in the air are not imaginable there can be no question of forbidding international air traffic." Wheaton claimed that "The sea is an element which belongs to all men like the air No nation then has the right to appropriate it." Another man deplored the existing state of affairs which made men victims to law and regulations, and pleaded that the air be kept free from degrading influences. Still another would have the air free because men cannot keep it within boundaries. The theories of these free-air advocates are at least interesting if not practical. They dreamt of an unrestricted air-space, where passing aircraft sped along their way disregarding man-made law, and spurning artificial ground boundaries with their puny squabbles To these dreamers, the heavens were a glorious Utopia, a sphere untrammeled with man-made laws, indeed a veritable Bolshevik Paradise.

Another group of philosphers believed in partial restriction of freedom of the air One says "The air is free, states have in time of peace and in time of war only such rights as are necessary for their conservation" Another shouts "Freedom for aeronauts, but full guarantee of conservation of the state and of its special interests. No horizontal limit." These conservative "Left-wingers" grant the absolute freedom of the air-space, in theory, but are practical enough to realize that the millenium has not arrived, and that until it does some means must be taken for guarding the state from air attack With this object in view they proceed to grant to the underlying state just enough jurisdiction of its air-space as to insure it from such attack. The air, however, is still theoretically free.

Another group of writers have made a radical departure in their conception of air sovereignty Reasoning by analogy they conceive of an air freedom restricted only by territorial atmosphere—similar to the territorial waters bordering a state. Oppenheim says "The territorial atmosphere is not a special part of the territory of the state, but the state must be allowed to control it and to exercise jurisdiction in it up to a certain height" Ferber says "Free, except a territorial zone, if possible not higher than five-hundred meters." These writers would portion off, as it were, a layer of air from one to ten thousand feet thick and call it territorial atmosphere. This territorial zone would cover the subjacent state, extending from the surface to a certain pre-arranged height In other words, hostile aircraft could maneuver at will over a neutral country just so they remained above the territorial layer The utter futility of such a regulation must be obvious to all World War veterans who saw combats taking place far above the ten-thousand foot level, and who heard bombs explode which were dropped from altitudes well over twenty-thousand feet.

Sovereignty over the Air-Space

The writers who believe that the sovereignty principle should govern the air are divided into two groups, those who believe in partial sovereignty, and the absolute sovereigntists Pietri believed in partial sovereignty He said "Sovereignty as high as it can be carried into effect, that is, determined by the range of artillery" Hilty says the same: "Sovereignty as high as the sway of the state reaches, that is, the same as regarding the sea, as far as artillery reaches—not fixed to a certain height." Partial sovereigntists would thus give the underlying state absolute control of the air-space within reach—that is, within artillery range This again is insufficient for full protection against aerial attack. Bombs can be dropped from any height.

The absolute sovereigntists are subdivided into moderates and extremists The moderates, as Westlake, believe in innocent passage for the airman Westlake says "Sovereignty to an unlimited height, restricted by the right of innocent passage for aerial navigation." Meyer says "The state has but limited sovereignty over the air-space, about the same as over the maritime belt." The moderates would give to the state full sovereignty with but a single restriction—the right of innocent passage. Aircraft plying their way peacefully through the heavens would pass unmolested through sovereign territory. Commercial craft, pleasure craft, scientific machines could proceed about their business without regard to the underlying state.

The extreme sovereigntists believe in full sovereignty without restrictions. Von Ullman says "State territory includes the air-space as far as one can penetrate with human means." Collard says "Full imperium to an unlimited height." Gemma says "Sovereignty to an unlimited height." The extremists insisted that every nation must have the right to regulate the use of its air-space in the manner best suited to promote the public interest No restrictions could be countenanced, since aircraft overhead were always overhead, whether ten thousand

or fifty thousand feet in the air. The theory which Gladstone expounded, the old common law theory, was here applied namely, that land had no limit either upwards or downwards, that it extended from the middle of the earth to the middle of the heavens.

A Modern View

The modern conception of air freedom and state sovereignty, as expressed in the report of the sub-committee on aeronautics at the Peace Conference, is an absolute sovereignty of the air-space over land and territorial waters free from any right of innocent passage. This theory denies to foreign aircraft in territorial air-space even as much right as foreign vessels now obtain in territorial waters. A British vessel bound for Jamaica from New York may take advantage of the current along the Florida coast by sailing within the territorial waters of the United States, that is within the three-mile zone. This is customary The British vessel has the right to use our territorial waters, or any other waters, so long as it plys in peaceful commerce. International law gives her that right. The aircraft, however, presents a different problem It involves a more intimate relationship as the aircraft is immediately over the land A vessel sailing the territorial waters of a state comes only within reach of the extreme edge of the state, whereas the aircraft flying overhead covers the interior of the underlying country

The analogy of the air-space to the sea is not accurate The sea is only adjacent to the land, whereas the air-space completely covers every foot of the land. Only the shores of a country are in contact with the sea, the farther out to sea one goes, the farther he is from land A vessels twenty-five miles out to sea can do little damage to a port Neither can it obtain at that distance much information of any value. An aircraft, on the other hand, still remains over the land, no matter to what altitude it rises. The entire state lies uncovered to the air A craft one mile in the air is as much over a state as a craft a thousand feet up, and likewise, a craft five miles in the air can still threaten the underlying country Bombs let fall from an altitude of five miles are quite sure to land somewhere To be sure, commercial aircraft peacefully winging their way over a foreign land, will not necessarily threaten the safety of the underlying country, no more so than the tramp schooner threatens the safety of the country along whose shores it happens to be passing The air, with its craft, however, has been designated as "national" by the different states, and for the present it must so remain Before the World War partial freedom of the air seemed at least probable, if remotely so, but at the present time with the stir of war still in the air, and with the consequent development of intensive nationalism, all freedom theories have been swept aside for the centuries-old doctrine of full state sovereignty

The Right of Innocent Passage

The doctrine of the right of innocent passage was nearly universally upheld before the war It was upheld by the Institute of International Law and by the international legal conventions called to consider the subject of aeronautics A machine in those days could rise from its hangar, traverse the heavens, and nothing would have risen over the matter So long as the airman behaved, as long as he remained at a suitable height, he was permitted to sail along unmolested. There were restricted territories, such as fortresses, but in the main the country was wide open to innocent passage. The war put an end to all civil flying. Only military aircraft were permitted in the belligerent states, and all flying was completely under military control Now that the different states have resumed to a great degree their pre-war conditions, it seems possible that innocent passage may again be permitted in time International mail routes have already been established, but this arrangement is more of an official matter between the individual governments, rather than the starting of innocent passage. England with her dominions will not readily support the doctrine of freedom of the air—she stands for full sovereignty France, on the other hand, upholds the right of innocent passage. The International Flying Convention of 1919 provides for the innocent passage of aircraft. Article 2 states: "Each contracting state undertakes in time of peace to accord freedom of innocent passage above its territory and territorial waters to the aircraft of other contracting states." So long as innocent passage is limited to "contracting states" there will be no universal freedom of innocent passage, but this is at least a start in the proper direction.

It is apparent that a state may prohibit flying over certain areas for the public welfare, or for military reasons. Such restrictions are natural and have never been contested Any further restrictions, however, will create a lot of bad feeling in the inland states The war created a number of states with no maritime boundaries, such as the present-day Austria, Hungary and Czecho-Slovakia. There are other states which have no sea coasts, such as Switzerland, Bolivia and Paraguay. If air passage is only to be had over native territory, or over the open sea, then these states are to have no commercial aviation, except at the will of the neighboring states This involves a serious problem Can Italy stop Switzerland from carrying on aerial commerce with Spain? Or can Germany prevent a party of Czecho-Slovaks from crossing German air-space by flying to Paris? Article 5 of the International Air Convention provides that no contracting state shall, except by a special and temporary authorization, permit the flight over its territory of an aircraft which does not possess the nationality of a contracting state. In other words, states not parties to the convention will be deprived of the common right of commercial access to the air The citizens of all nations have certain fundamental rights, one of which is the right to peaceful commerce, and to deprive the citizens of one nation the right to carry on peaceful aerial commerce with another nation would be to deny them a certain portion of common freedom.

The entry of all nations into the International Air Convention, in time, will automatically help to solve the question of sovereignty and air freedom The individual state must retain full and complete sovereignty of the air-space over its territory, but at the same time the air-space cannot be closed to through transit, in times of peace, of foreign commercial aircraft Innocent passage must in time become recognized as a fundamental principle of international aerial law. The International Air Convention, as well as the International Juridical Committee on Aviation in 1909, have declared themselves in favor of regulated international air regulation, with absolute state sovereignty as a national policy The next step in the progress of aerial law will come about when the Convention recognizes the principle of innocent passage as an international policy

Experimental Research on Air Propellers, IV

N. A. C. A. Report 109

This report is a continuation of a report on the same subject published in the Fifth Annual Report of the N.A.C.A. The research was conducted in the aerodynamical laboratory of Leland Stanford Junior University, and the report was prepared under the direction of Dr W. F. Durand and Prof E. P. Lesley The report states the results of investigations made upon numerous propeller models at the request of the Subcommittee on Aerodynamics, and contains valuable data to those interested in the design of air propellers. The discussion accompanying the report is necessarily somewhat brief, as the report is to be a part of the general report which will include a review of all the propeller investigations that have been conducted at Leland Stanford Junior University This general report will be ready for publication with the Seventh Annual Report of the Committee

A copy of Report No 109 may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D. C

Air Service Places Large Order

The U. S. Army Air Service on April 1 placed orders for 200 Thomas-Morse MB-3 pursuit airplanes and spares with the Boeing Airplane Co, of Seattle, Wash, and for 35 Martin Bombers and spares with the L. W. F. Engineering Co, of College Point, Long Island, N. Y. The value of these orders aggregates nearly $2,500,000

Balloon Racing*

A Game of Practical Meteorology

By Ralph H. Upson

Transportation has always been more or less influenced by the weather. During the last fifty years, this influence has been somewhat lessened by the increasing use of automotive vehicles. Now, however, the advent of commercial air navigation makes weather more of a factor than it has ever been before, so much so indeed that the success of aircraft for commercial use will almost depend on how far the design progress can be paralleled by developments in three-dimensional meteorology. Now the question is: How can we best study this very important factor of weather in its application to aeronautics? Meteorology is no more an exact science than medicine is. To be sure, there are laws and principles that can be implicitly relied upon, but the great bulk of our future development for some time to come must depend on the accumulation and coordination of plain *facts, experience,* and *practice.* The performance of any aircraft (whether heavier- or lighter-than air) is a resultant of two factors: (a) The power plant of the craft, and (b) the surrounding air, or broadly speaking—the weather. Quantitatively, the effect of the weather is usually unchanged by a difference of speed and maneuverability of the aircraft. For example, a 20-mile side wind blows an airplane or airship sideways at just 20 m.p.h. regardless of its speed of advance.

As in other branches of science, the best way to study this important subject from a practical standpoint is to separate it as far as possible from outside influences which only disturb the observations and confuse the result. The free balloon is almost ideally suited to our present purpose for the following reasons:

1. Having no motor, its control is entirely dependent on coordination with existing weather conditions. The performance of a balloon is exactly like that of a free particle of air with the addition of altitude control.

2. The entire freedom from pitching, vibration, noise and wind, permits the most delicate observations to be made.

3. The simplicity and safety of operation makes a balloon especially desirable for a great variety of experiments. A free balloon is so safe that it is *practically* fool proof. It would take considerably more than an *ordinary* fool to hurt himself in one.

The progress in other branches of aeronautics has, if anything, increased the value of the free balloon for training. During the war all our airship pilots and a large proportion of our kite-balloon observers received preliminary training by free balloon. For training in navigation and meteorology it has also been advocated for airplane pilots. But its greater and broader value lies in the general stimulus to meteorological knowledge to be gained by its development as a recognized sport. And it is in no disparagement of its scientific and practical importance to say that as a sport, ballooning is the finest that can be imagined. It is also very moderate in cost. Recent developments in fabric and gas generators put ballooning within reach, financially and otherwise, of any moderate-sized club.

The *safe* piloting of a free balloon is easily and quickly learned. There are only two controls, ballast and gas. To go up or stop coming down, throw out ballast. To come down or stop going up, let out gas. The control of altitude and with it the choice of the desired wind currents depends only on the proper expenditure of ballast and gas.

Ordinary flights usually last from one to twelve hours, the landing being planned for a time and place that will best suit the convenience of the passengers. But pre-arranged plans are seldom entirely fulfilled. To realize them the pilot must constantly match his wits and skill against the prevailing wind conditions, which are never twice the same. An interesting story, as well as a scientific treatise could be written about every balloon flight that was ever made.

The highest art of ballooning finds expression in the national and international races for distance which are held every year These commonly run anywhere from 400 to 1,200 miles distance and 18 to 60 hr duration. Having been a loser myself in the last big race, I need not be at all bashful to say that one of these races will draw on almost every talent that a man has—knowledge of navigation and meteorology, experience in its application, ability to size up the actual conditions, good judgment in their interpretation, practical skill in handling the balloon, firmness in adhering to a good plan of action but always with eyes and mind open for a

U. S NAVAL FREE BALLOON ENTERED IN THE 1920 GORDON BENNETT RACE

better one, courage or caution where necessary, and plenty of plain physical endurance without forgetting good sportsmanship: these are a few of the qualities one can use to good advantage in a balloon race. Of the nine international races for the Gordon Bennett cup since 1906, Belgium has been winner once, France, once, Switzerland once, Germany twice, and the United States four times. This year the race will start from Belgium because of the Belgian lieutenant, de Muyter's, great victory last year.

Our most immediate concern now is to see that America is well represented in this year's race. We are allowed a total of three teams consisting of pilot and aid for the three different balloons, each nation being limited to the same number. The only way to organize is to organize for a purpose, the only purpose in this case being to bring back to this country the famous Gordon Bennett trophy The different component parts of the plan must include attention to the following

1. *Financing the expedition* is outside the scope of the

* From the Monthly Weather Review

present article, but it may be remarked that America in the past years has never failed to have representatives in this race.

2. *Equipment* is relatively unimportant, the only real necessity being a fairly tight envelope and good instruments. A racing balloon it should be noted is a much cheaper proposition than either a racing yacht or an airplane. There are probably at least a dozen balloons in this country which would be satisfactory to use.

3. *Personnel* is the most important item of all. We have an unusual rich choice now owing to the interest of the Army and Navy in free ballooning, and having all the pilots who were trained during the war

The history of balloon racing up to the present time shows conclusively that it is taking on more and more of a meteorological character. In the past, races have been occasionally won by mere practical skill in operation of the balloon, but the time when this is possible is rapidly passing, if indeed it has not already passed. In the future, meteorological knowledge instead of being a secondary factor in the assets of a team, will be absolutely the controlling factor.

The record of the race from Birmingham, Ala., last fall is a very interesting study in this connection. The winner was a trained meteorologist* besides being a good balloon pilot. His performance in that race sounds almost incredible, but the facts can not be avoided. He, the winner, among all those who really stayed in the race, landed the very earliest. All started from Birmingham, Ala., between 5:30 and 6 p.m., Oct. 23. At 9:30 a.m. of Oct. 25 the winner was landing in the State of Vermont, while most of the other balloons were floating gently over Indiana and Michigan. One of these (we need not mention names) had ballast in plenty for another 24 hr., but would have needed twice that length of time to reach the distance marked off by the winner. An altitude of up to more than 20,000 ft. was tried without success, the experiment at that time only serving to exhaust the ballast supply. At 2 o'clock in the afternoon (of the third day) landing was finally made near Detroit, at approximately the same spot where the winner had passed over about 16 hrs. before.

These are striking coincidences, it must be admitted, but there is plenty of other evidence at least as strong showing the great importance of meteorology in modern balloon racing. And the shoe fits both ways. Not only does balloon racing need meteorologists for its best development, but meteorologists need the experience and stimulus which free ballooning is best able to give.

Ballooning is by all odds the best practical training for anyone who would use weather knowledge. Then why not for professional meteorologists? To be perfectly frank, ballooning is no longer important for the making of structural experiments from an engineering standpoint. The more definitely practical types of aircraft, such as airships and kite balloons, have reached a point where they are no longer dependent on free balloon experience for their structural requirements. But the keen struggle of wits against weather and the wonderful spirit of adventure which is an intimate part of even the shortest balloon flight, will always keep alive this fine sport. It is not given to most of us in these modern days to make voyages of exploration to unknown parts of the globe, but this spirit of adventure and exploration is still alive in human hearts and it is to this that free ballooning makes its great appeal, thus increasing and extending the value of its scientific service.

The recent unintentional flight of a Navy balloon to Hudson Bay has furnished striking proof of how people will respond to anything that stirs this spirit. But there is one unfortunate thing about ballooning from a standpoint of the general public. It is hard for spectators to see anything more of a race than the start. Hence, there is more than the usual importance to be placed on consistent development and interpretation by those who are naturally the nearest to it. We must get away from false leads and put ballooning where it belongs, squarely on the basis of sport and meteorology

Book Reviews

STRUCTURAL ANALYSIS AND DESIGN OF AIRPLANES (Issued by the Engineering Division of the Air Service)

This book has evidently been prepared with considerable care and thoroughness. It will prove extremely valuable to all designers of aircraft. It is well printed and got up, is complete, yet contains nothing that is superfluous, and besides the systematic development with examples of structural analysis, contains a great deal of useful data in tabular form.

The theory of analysis is presented in sufficient detail to warrant the use of the book as a text for technical school courses. Quite naturally the methods of analysis which are described are those in favor with the Air Service. But as these are sound and have the advantage of many comparisons with static tests they may be considered as extremely reliable. A valuable discussion is made of the worst loads which may probably come on the various parts of structure, and the difference between load factor and safety factor are clearly drawn. An elaborate analysis of a chassis containing redundancies is followed through by the method of least work and it is surprising that more attention is not given to the effect of redundancies in cellules.

The Berry method of spar analysis is not mentioned in cases where it is necessary, reliance being placed on an approximate process of calculating secondary moments due to deflection. Illustration of analyses of various parts of the airplane by means of examples followed through in some detail is very effective.

The book is a very useful aid in general design, particularly of military machines, although there is a noticeable absence of data on seaplanes and control surface areas.

This book was prepared by B. C. Boulton, in charge of stress analysis at McCook Field, assisted chiefly by A. S. Niles and H. M. Proot.

ALL THE WORLD'S AIRCRAFT, 1920 Edited and Compiled by C. G. Grey, Editor, *The Aeroplane* (Sampson, Low, Marston and Co., Ltd., London 466 pp., 772 ill.)

The well known reference book on the world's aircraft and aero engines, which was founded in 1909 by the late Fred T. Jane, founder of *Fighting Ships*, and which has since regularly appeared every year, has just been issued for the eleventh time.

The 1920 edition of Jane's, as the book is colloquially referred to, deals mainly with post-war aircraft, and for this reason lists a great number of commercial machines. The historical section, which took up a large amount of space in past editions, has been dispensed with and the whole subject matter has been brought up to date with regard to both types of aircraft described and the organization of the various fighting air forces and commercial enterprises.

The book as a whole, in addition to its use as a reference work, gives a very exact picture of the state of aeronautics throughout the world at the time it was compiled. The same arrangement which has proved so popular in former years has been retained, namely, that of listing the descriptions of aircraft under the names of the respective constructor and country of manufacture. The data given are in general very complete and the drawings and photographs take up more space than the text. Very few machines are listed that are not illustrated in some way and those that are not, are mostly of minor importance. The data and information which Jane's contains has mostly been gathered from official sources. Its reliability is therefore of a sufficiently high order and probably as high as it is possible to make it in the constantly fluctuating state of aeronautics. The American section, which was compiled by the Editor of AVIATION AND AIRCRAFT JOURNAL with the cooperation of the Manufacturers Aircraft Association, affords a comprehensive encyclopedia of American aircraft at the end of 1920, when the book went to press.

* A personal account of Lieut De Muyter's experiences in this race is given in L'Aérophile Dec. 1-15 1920, pp 366-367 under the title, "How I won the Gordon Bennett cup" —EDITOR

Standardizing Municipal Air Ordinances

When Maj. F. H. La Guardia, President of the Board of Aldermen of New York announced that he was preparing an ordinance to regulate air navigation of New York City, he received requests from many cities for copies of the proposed ordinance. The Board of Aldermen of Chicago had under consideration a similar ordinance and realizing that it would be of a great advantage to all cities to have similar ordinances, sent for the La Guardia ordinance and after making several changes to clarify the meaning of certain paragraphs sent it to the New York Aldermen. The latter adopted most of the changes suggested by Chicago. As a consequence the New York and Chicago air ordinances are practically alike, which will be of great benefit to airmen operating over these cities.

Resolution of the Chicago Board of Aldermen

The Chicago Board of Alderman passed the following resolution presented by Alderman Link, who has been active in the preparation of an air ordinance for Chicago:—

WHEREAS, The rapid development of aviation has created a situation which not only affects all consideration of our future, national security and commercial development but also the peace and security of our daily life through the increasing use of aircraft for sport and commercial purposes; and

WHEREAS, It is at once apparent that the legal status and use of such aircraft should be determined upon considerations of broad public interest and national welfare and that because of the great speed attained and the limitless medium through which aircraft operate, these questions cannot be considered from a legal or sectional viewpoint but only upon a national or international basis, and

WHEREAS, The only competent and authoritative study and determination that may be made of the requirements of the situation is through the Congress of the United States, now therefore, be it

RESOLVED, By the City Council of the City of Chicago representing a population of nearly three million people, That the Congress of the United States be urged to recognize the necessity of accepting this responsibility and to at once adopt a strong aeronautical policy and perform its full duty in connection therewith by the enactment of legislation making such policy effective and at the same time assuming control and direction of the operation of all aircraft in a manner that will facilitate and stimulate its use but at the same time conserve other interests through the promulgation and administration of suitable rules of the air and that pending such assumption of National control, be it further

RESOLVED That the City Council of the City of Chicago have prepared and submit an ordinance designed to correct and control any improper or dangerous use of aircraft over the limits of the city for the purpose of minimizing the possible danger to life and property in the city until such time as complete and competent control of the operation of aircraft is assured by the Federal Government; and be it further

RESOLVED, That a copy of this resolution be transmitted forthwith to the President of the Senate and the Speaker of the House of Representatives of the Congress of the United States

The New York Air Ordinance

The New York air ordinance was passed by the Board of Aldermen on Feb. 15, and approved by the Mayor, Feb. 23. It reads as follows:—

An Ordinance in Relation to the Operation of Aircraft Over The City of New York

Be it Ordained, by the Board of Aldermen of The City of New York, as follows:

Section 1. That until the Congress of the United States passes legislation to control and direct the operation of all aircraft over all of the territory and territorial waters of the United States, at which time the provisions of this ordinance shall automatically cease and become void, all aircraft operating from or over the geographical limits of The City of New York shall be governed by the following conditions and terms.

Sec. 2. For the purpose of this ordinance the term "aircraft" shall mean any airplane, hydroplane, seaplane, dirigible balloon or other apparatus carrying one or more persons into or through the air, propelled by currents or by power or motors contained in said apparatus; the term "pilot" shall include every person who, being in or upon any aircraft, undertakes to direct its ascent, flight or descent in the air, and the word "flight" shall include every kind of locomotion by aircraft; "a known established recognized field or place of landing" shall mean a public or private field or place of landing for such purpose where the landing of airplanes is permitted by the owners thereof and such fact is publicly known. An "emergency place of landing" is any place where a landing may be effected in an emergency without endangering in any way life or property on such place of landing; "limits of The City of New York" shall mean the land or air above the land or pier heads of any of the five Boroughs.

Sec. 3. No aircrafts in the air over the limits of The City of New York shall be guided or controlled by the pilot in a manner designed to give any demonstration or trick flying or aerial acrobatics or be given any manipulation of the controls which may tend to divert the aircraft from a normal flight with every consideration for stability and safety.

Sec. 4. No aircraft shall fly over any part or section within the limits of The City of New York at a height lower than that enabling such aircraft to glide in any emergency and at all times to a known, established or recognized open or unobstructed place on land or water, nor shall aircraft under any circumstances or occasion, special or otherwise, fly at a height lower than 2,000 feet, except at the beginning or end of a flight, in accordance with the provisions and limitations of this ordinance, and when not within gliding distance of a recognized or a known established or recognized field or place of landing.

Sec. 5. No person in aircraft shall cause or permit to be thrown out, discharged or dropped any ballast, instruments, tools, containers, handbill, circular, card or other matter whatsoever, unless it be directly over a place established for that purpose, and all equipment carried in aircraft shall be securely fastened in place before leaving the ground.

Sec. 6. Aircraft approaching each other head on from opposite or different directions each shall alter its course to the right in passing.

Sec. 7. Lighter-than-air craft shall at all times have the right of way over heavier-than-air craft.

Sec. 8. Every person violating the provisions of this ordinance shall be guilty of a misdemeanor and upon conviction thereof shall be punished by a fine of not less than fifty dollars ($50) or imprisonment not exceeding one year, or both.

Sec. 9. This ordinance shall take effect immediately

The Chicago Air Ordinance

The Chicago air ordinance passed by the Board of Aldermen is as follows:

Rules and Regulations Governing the Operation of Aircraft on Chicago

Be it ordained by the City Council of the City of Chicago:

SECTION 1. That until the Congress of the United States passes legislation to control and direct the operation of all aircraft over the territory and territorial waters of the United States, at which time the provisions in this ordinance shall automatically cease and become void, all aircraft operating from or over the geographical limits of the City of Chicago shall be governed by the following conditions and terms.

SECTION 2. For the purpose of this ordinance the term "aircraft" shall mean any airplane, hydroairplane, seaplane, dirigible, balloon or other apparatus carrying one or more persons into or through the air, propelled by currents or by

power or motors contained in said apparatus. The word "flight" shall include every kind of locomotion by aircraft. "A known, established, recognized field or place of landing" shall mean a public or private field or place of landing for such purpose where the landing of airplanes is permitted by the owners thereof and such fact is publicly known. An "emergency place of landing" is any place where a landing may be effected in an emergency without endangering in any way life or property on such place of landing. "Limits of the City of Chicago" shall mean the land or water within the city limits and the air thereover.

SECTION 3. No person shall guide an aircraft in a manner designed to give any demonstration of trick flying or aerial acrobatics, or give any manipulation of the controls which may tend to divert the aircraft from a normal flight with every consideration for stability and safety.

SECTION 4. No person shall fly over any part or section within the limits of the City of Chicago at a height lower than that enabling such aircraft to glide in any emergency and at all times to a known, established or recognized open or unobstructed place on land or water, nor shall any person under any circumstances, special or otherwise, fly at a height lower than 2,000 feet except at the beginning or end of a flight.

SECTION 5. No person in aircraft shall cause or permit to be thrown out, discharged or dropped any ballast, instruments, tools, containers, handbill, circular, card or other matter whatsoever, unless it be directly over a place established for that purpose, and all equipment carried in aircraft shall be adequately fastened in place before leaving the ground.

SECTION 6. Aircraft approaching each other head on, or nearly head on, so as to involve risk of collision, shall alter their course to the right in passing and under all other conditions the aircraft having the other on its right shall keep clear.

SECTION 7. Lighter-than-air craft shall at all times have the right of way over heavier-than-air craft.

SECTION 8. Every person violating the provisions of this ordinance shall be guilty of a misdemeanor and upon conviction thereof shall be punished by a fine of not less than $50.00, nor more than $200.00, or imprisoned in the workhouse for a term not exceeding one year, or both such fine and imprisonment.

SECTION 9. This ordinance shall be in force and effect from and after its passage.

Naval Aviation and Latin America

Once more Naval Aviation has scored in furthering the cordial relations between the United States and our Latin American neighbors to the South, and in stimulating the interest shown by those southern Republics in aeronautical matters.

Recently Governor Balarezo, of Lower California, and his private secretary, Alfanso Schnabl, visited the Naval Air Station at San Diego and were given a flight in the Navy airship B-18 over the beautiful city of San Diego and along the adjacent shore. The governor, aside from being an able administrator, is a praticularly keen business man deeply impressed with the importance of commercial aeronautics, particularly to a country with the difficult terrain of Lower California. Accordingly, he expressed the keenest pleasure in the courtesy shown him by the officers at San Diego, and he stated, that, in his opinion, the establishment of commercial aeronautics in Mexico or in Lower California, at least, would be accomplished in the very near future.

The visit of Governor Balarezo to the Naval Air Station at San Diego is in line with previous incidents of the same nature in other Central American countries. The frequent visits of navy fliers from the Naval Air Station at Coco Solo, C. Z., to cities along the coast of the Spanish Main, has resulted in the operation of at least one commercial air line in the Republic of Columbia and the projected establishment of others in Panama, Costa Rica, and Nicaragua. And, too, the astounding performance of the seaplane squadrons of the Pacific Fleet, which flew from San Diego to Balboa in the recent joint fleet maneuvers South of Panama and along the West coast of South America, together with the flight of the seaplane divisions of the Atlantic Fleet from Hampton Roads to Panama and Balboa, have brought aviation to the official attention of all the Latin-American countries along the flight routes.

The Navy in these record performances has not only proved the value of long-distance reconnaissance flights in connection with the Fleet, but has given a further demonstration of the practicability of large airboats for commercial traffic.

A Letter

Editor, AVIATION AND AIRCRAFT JOURNAL —

In the editorial section of the February 21 issue of your publication I have noted an article headed "Exaggerated Refinement in Stress Analysis" which is an exaggeration and overstatement of the true situation.

The writer rants against the introduction of the theorem of Least Work into the structural analysis of airplanes, but I doubt if he can name a biplane designed in this country in which the incidence or stagger wiring has been designed by this method. The objections to Least Work create a false impression that it is in common use. It is like objecting to seven place logs in engineering computations. The objections may be sound, but nobody is interested.

When he comes to discuss the so called "Berry method" his ignorance of the entire subject of refined methods of stress analysis becomes apparent. His language suggests that his knowledge of the "Berry method" is limited to what may be gained by a glance at a table of Berry functions, else he could not have remarked that the "Berry method * * * is showing us how to compute stresses due to offset wire pulls." Such a statement is not to the point and leads one to conclude that the writer is arguing about something whose fundamental purpose has entirely escaped him. Every engineer knows that in calculating the stresses in a continuous beam which is subjected to both lateral loads and compressive end loads the ordinary Three Moment Equation is often not sufficiently precise and errs on the unsafe side, and he must turn to the more involved General Theorem of Three Moments to take account of the deflection of the beam under load. Mr. Arthur Berry has arranged this general theorem in a convenient form and has calculated a table of functions which amount to a series of coefficients to express the elastic properties of the beam which may be introduced into the ordinary everyday Three Moment Theorem. A table of Berry functions is no more mysterious than a log table and the time required by a competent engineer to use Berry's short cut to the General Theorem is insignificant, and the results of his work are much more reliable.

I must also disagree with your editorial writer's conclusion that the present state of the industry, when but few machines of a given type are being built, is the proper time to attempt to shave a few dollars off the engineering costs by the use of rough methods of stress analysis. Quite the reverse. In the days when machines were being produced in quantity, the cost of the machine which was sacrificed to static testing to check up the stress analysis could be easily assimilated, but becomes a serious matter when only a very few planes are produced.

The ultimate end of refinement in the structural analysis of airplanes is to produce a machine which will be an harmonious whole; where each portion of the structure is just as strong as need be and no stronger. Real progress toward the attainment of this ideal can be made only by making full use of the results of research not only in the properties of materials, but equally in the methods of stress analysis.

J. C. McCARTHY

Limitation of Flying Cadets

In regard to the effect of H. J. Res. 440 upon the number of flying cadets authorized by the act of June 4, 1920, the J. A. G. states: This office has held that the resolution clearly expressed the intent of Congress that there should be no more enlistments until the number of enlisted men was reduced to 175,000. Since the flying cadets are enlisted in the Air Service it would be in violation of the resolution to enlist them until the number of enlisted men has been reduced to 175,000.

The New French Aviation Subsidies

Some detailed information is now at hand with regard to the new French aviation subsidies which have come into force on *Subsidy for Purchase*—This subsidy consists of a grant by the State of half the value of machines employed for March 1, 1921. The sum of 33,215,000 Francs ($6,410,000 at par value) which the French parliament has voted for commercial aviation, applies to the fiscal year 1921-22 and not, as previously stated, to last year.

The subsidies to be granted are of *two* kinds—

(*a*) A subsidy for purchase, and

(*b*) A subsidy for public transport.

In all cases the subsidies will only be granted, subject to the approval of the Under-Secretary of State for Air, to French subjects and companies employing French material and French pilots and personnel.

The total effect of the new regulations will be considerably to increase the amount of the subsidy. The purchase subsidy, as also the subsidies for depreciation, crew and gasoline, can be obtained without carrying any commercial load.

Method of Allocation of Subsidies

Subsidy for Purchase—This subsidy consists of a grant by the State of half the value of machines employed for touring and transport by air, and will not be given to any business connected, directly or indirectly, with the sale of aeronautical material.

The types of machine to be subsidized and the value thereof will be fixed by the Under-Secretary of State for Air. No subsidy will be given for aircraft built before July 1, 1920, and aircraft bought before Jan. 1, 1921, which conform to the conditions laid down will receive subsidies reduced in proportion to the number of hours already flown.

The purchaser receiving a subsidy must undertake (1) that he will keep the machine in good condition and report to the Under-Secretary of State when it is unserviceable for any reason, (2) that the machine does not leave French territory without the consent of the Under Secretary of State, (3) that he will not sell the machine without the consent of the Under-Secretary of State.

Subsidies for Transport—The subsidies for transport are granted only to legally constituted French companies, carrying out regular air services of recognized utility. The value of the subsidy varies according to the nature of the enterprise, the type of material employed, the regularity of the service and the commercial turnover.

(*a*) *For time and Distance Flown, in francs per Flying Hour*—

(1) Depreciation $\frac{1}{2}\left(\frac{P + 1.5\,p}{200}\right)$ for land machines

$\frac{1}{2}\left(\frac{P + 1.5\,p}{150}\right)$ for seaplanes

(2) Crew $0.10\left(Em + \frac{nHP}{2}\right)$ for land machines

$0.40\left(Em + \frac{nHP}{2}\right)$ for seaplanes

(3) Transport $\frac{KV^2T}{1000}$ for land machines

$\frac{1.8\,KV^2T}{1000}$ for seaplanes

(4) Gasoline $\frac{0.250\,nHP}{0.65} \times \frac{p'}{2}$ for stationary engines

$\frac{0.320\,nHP}{0.65} \times \frac{p'}{2}$ for rotary engines

Where P is the price of the aircraft as fixed by the Under-Secretary of State for Air.

Where p is the price of the engine as fixed by the Under-Secretary of State for Air.

Where p' is the price of the gasoline, to be fixed quarterly.

Where Em is the average length of a stage on the route flown.

Where nHP is the horsepower.

Where K is a co-efficient depending on the average length of a flight and on whether the route is entirely in France, crosses over French Africa, or is international.

Where T is the number of tons of commercial load carried.

Where V is the speed in kilometers per hour at 2,000 meters.

(*b*) *On Turnover*—This subsidy will be granted at the rate of 0.75 francs per passenger kilometers and 0.0005 francs per kilogramme-kilometer of goods, carried at fares and rates approved by the Under-Secretary of State for Air.

Special Conditions Governing Grant of Subsidies

The company must possess a minimum number of machines equal to twice the quotient obtained by dividing by 200 (in the case of land machines) and 150 (in the case of seaplanes) the number of flying hours. (Represented by the total annual distance flown by the company's machines at a speed of 130 km.p.h.)

The company must employ as a minimum the following personnel—

(*a*) One pilot for every three machines.

(*b*) One mechanic for every 300 hp. utilized.

The rates and fares which may be charged by companies are fixed according to the following tariff laid down by the Under-Secretary of State for Air—

Passengers, .80 francs per passenger-kilometer.

Goods, .015 francs per kilogramme-kilometer.

Reduction of Fares on Certain Routes—In effect, the new subsidies will produce the following reductions in passenger fares (for flying only, not including terminal charges)—

Single fare Paris-London, reduced to 300 francs.

Single fare Paris-Strasbourg, reduced from 500 to 150 francs.

Single fare Paris-Prague, reduced from 1,500 to 600 francs.

Belgian Colonial Aviation

The progress of aviation in the Belgian Congo is remarkable, judging from recent reports. Thanks to the financial support of King Albert, who is himself an enthusiastic aviator, a flying mission left Belgium for the Congo Colony in Oct., 1019, and the first flight actually took place there in March, 1920. Since that date a regular flying service has been in existence between Kinshasa and Coquilhatville, in the vicinity of Gombe, at the junction of the Ubanghi. An extension from Gombe to Lisala will be inaugurated during this month on the arrival of the next steamer, and the service from Lisala to Stanleyville, a distance of about 380 miles, will be working before the end of this spring. Flying boats are being employed, the course of the Congo being followed as far as it is possible. Up to recently, Stanleyville was entirely dependent upon the small river boats on the Congo for its mail services, the upward voyage taking twenty days, the return occupying fifteen days. When flying regularly it is estimated that hydroplanes will not exceed three days on the trip. Up to the present to send a letter and get a reply from the Congo has usually meant a delay of three or four months. When the aerial mails are completed senders will be able to obtain replies on the return of the mail steamer which has carried the original letters. Great importance is attached to the development of aviation in the Congo and the Societe Forminiere, which exploits the diamond mines in the Kasai at Djoko-Punda, is preparing to establish an air service between Kinshasa and their works. The line will cover a distance of 500 miles in two days as compared with the thirty-five to forty days at present required to get to the mines. A hydrographic map of the river Congo has also been decided upon, and it is hoped to complete the work by hydroplane in about three years time, as against ten to fifteen years in the ordinary way.

The energy and intelligence exhibited by the Belgians in the development of their colonial aviation are altogether remarkable.

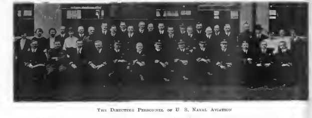
Staff of the Director of Naval Aviation

The accompanying picture shows the entire personnel of U. S. Naval Aviation in Washington, D. C.

In the front row, from left to right, are.—Lieut. Comdr. E D. Stanley, Supply Officer, Major A. H Turner, in charge of Marine Corps Aviation, Lieut. Comdr J P Norfleet, Lighter-than-air Craft, Comdr E. G Allen, Apportionment of Funds, Comdr. V C Coman, Liaison, Army and Navy, Comdr R. M Griswold, Naval Air Stations, Capt. W A Moffatt, Director of Naval Aviation, Capt. T T. Craven, former Director of Naval Aviation; Comdr W G Giles, Assistant Director of Naval Aviation, Comdr K. Whiting, War Plans, Comdr T M Jewell, Aviation Instruments and Naval Observation, Lt. Comdr P. N L. Bellinger, in charge of Heavier than-air Craft; Lt. Comdr Z. Lansdowne, in charge of Lighter-than-air Craft.

Second row, left to right —Capt. H E Williams, Assistant in charge of Marine Corps Aviation, Lt. Comdr R A Burg, Aviation Personnel. Comdr S. M Kraus, Aircraft Engines; Comdr J C Hunsaker, Design and Construction, Lt. Comdr G de C. Chevalier. Aircraft Carriers, Lt. Comdr W Capehart, Materials Section, Lt Comdr G F Fulton, Assistant to Comdr Hunsaker, Lt. G. W Kirman, Assistant to Major Turner, Marine Corps.

Third row, left to right —Lt Comdr G R. Ranken; Lt. C A Tinker, Information, Lt. Comdr B G. Leighton, Assistant to Commander Kraus; Lt. K B Bragg, Aviation Construction. Lt. Comdr P. E. Byrd, Information; Lt C E Keiser, Aerography; Lt. T. C Gibbs, Supply Officer



THE DIRECTING PERSONNEL OF U S. NAVAL AVIATION

National Balloon Race, May 21, 1921

The Birmingham Civic Association, the Inter-Club Council of Birmingham, representing the Rotary, Kiwanas and other clubs have invited the Aero Club of America to hold the National Balloon Race at Birmingham on May 21, 1921, and the sanction has been awarded to them to hold the race on that date. The cash prizes and trophies to be competed for will be announced later The foremost balloon pilots of the country have signified their desire to enter this race, which promises to be one of the most successful ever held on account of the wide interest in ballooning and the necessity of selecting a strong team to go to Belgium and bring back the Gordon Bennett International Balloon Cup which was won by Lt. Ernest Demuyter last year

The following pilots have already signified their intent on of entering the races. Bernard von Hoffman, St. Louis, J S McKibben, St. Louis, John Berry, St. Louis, Lt. Louis A Kloor, U S N., Roy Donaldson, Springfield, Ill., Warren Rasor, Brookville, O., H. E. Honeywell, St. Louis, Ralph Upson, New York, U. S. Army and U S. Navy.

The Junker All Metal Monoplane

Recent changes in the fuel feed line and carburetor air intake in the Junker monoplane are said to have eliminated the fire hazard, for which these machines have received considerable adverse criticism. In the changes referred to, made by the Engineering Division at McCook Field, are included flexible gasoline line connections instead of rigid ones and the carrying of the air intake outside the cowling where there is no danger of oil and gasoline around the engine being ignited by backfiring

Performance tests have been made by the Engineering Division, with this airplane equipped with the 185 hp B M W engine, with the following results Maximum speed 1912 m p h., climb 10,000 ft 27 3 min, service ceiling 13,200 ft, absolute ceiling 15,900 ft., endurance (including climb) at 10,000 ft., 7 hr 35 min, minimum speed at sea level 52.1 m p h

The weight of this machine is as follows Empty 2317 lb., crew 655 lb, fuel 560 lb, oil 64 lb Total weight 3605 lb. Wing loading 8 64 lb./sq ft. Power loading, 14.8 lb /hp.

Aircraft Distress Signals

The London office of the United States Shipping Board has issued a notice to all masters and radio operators of Shipping Board vessels with respect to action which may be taken in case of aerial distress. These signals are in accord with the International Air Convention signed by representatives of the allied powers at Versailles. The following is the notice issued —

Mariners and others are notified that when any aircraft is in distress and requires assistance, the following shall be the signals displayed by her, either together or separately —

1 The International Signal "S O S" by means of Visual or Wireless Telegraphy

2. The International Code Signal of Distress indicated by N C

3 The Distant Signal consisting of a square flag having above or below it a ball or anything resembling a ball

4. A continuous sounding with any sound apparatus.

5 A signal consisting of a succession of White Very's lights, fired at short intervals.

NOTE The above signals are subject to such modification as shall be published from time to time

Curtiss Marine Flying Trophy

The Contest Committee of the Aero Club of America will shortly draft the rules for a flying boat competition which it is intended to hold next summer on Long Island Sound. One of the events scheduled will be a race for the Curtiss Marine Flying Trophy.

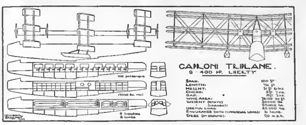
Naval Air News

Kite Balloon Controls Target Practice

In working out plans for the defense of the Panama Canal, the utmost cooperation obtains between the Coast Artillery at Fort Randolph and Naval Aviation at the U S. Naval Air Station, Coco Solo.

During the season's coast artillery target practice kite balloons from Coco Solo were used for shot spotting purposes with unusual success. In working out its problems, the Army had considerable difficulty in getting accurate information to the plotting room quickly enough to be of real value. Accordingly, a telephone line was rigged from Fort Randolph with about two miles of wire, which was attached to a Navy kite balloon operating from an Eagle boat. Another Eagle boat towed a suitable target, and, with the aid of an Army field-telephone kit, excellent communication was maintained between the kite balloon and the plotting room at Fort Randolph

For several days the big gun firing from the Fort was practically controlled from the kite balloon, there being an Army officer in the balloon in charge of the spotting most of the time. Navy spotters, however, were given valuable practice and several of the pilots at Coco Solo have become particularly efficient as coast artillery spotters.



OUTLINE DRAWINGS OF THE CAPRONI TRIPLANE EPOCA
From The Aeroplane

Editors at Naval Air Station

During the recent Southern Conference of National Editors, Governor C M Hardee, of Florida, with more than 200 delegates of the conference, visited the U S. naval air station at Pensacola for an inspection of its aerial activities. About forty planes took the air, including a formation of eight twin-motor boats, HS-boats engaged in gunnery work, R-6-L's dropping torpedoes, and squadrons of N-9's in acrobatic flying Three non-rigid airships were in the air at the same time

The Governor and the delegates expressed the keenest interest in the work at Pensacola. Many of the delegates, who for the first time saw large formations of aircraft in operation, were of the opinion that should bankers and financiers have an opportunity of observing aerial activities conducted en masse, so to speak, commercial aviation would be greatly benefitted as a result. In other words, if bankers familiarized themselves with the remarkable advancement made in aviation since the War, commercial aeronautics would receive more generous support from financial interests in the country

The day after Gov Hardee and his guests visited Pensacola Capt G F. Cooper, U. S N., Commandant of the 8th Naval District, inspected the station. As a demonstration of squadron maneuvers, forty-two planes were in the air by 8:55 in the morning, a number greater than all of the aircraft the Navy had in commission on April 6, 1917, at the beginning of the war.

ZR-2 Crew Training on R-80

Additional training facilities for the crew of the rigid airship ZR-2 now rapidly nearing completion in England for the U. S. Navy, have been made available by the acceptance of the British Air Ministry of the new rigid airship R-80

The R-80 was built by Vickers, Limited, at Barrow, and flown to the Royal Air Force hangars at Howden, Yorkshire, the same station at which our Navy fliers are making their training flights. Heretofore the American personnel have been using the wood-frame rigid R-32 for training purposes, an older type of airship than either the R-80 or the ZR-2. The R-80 is the most completely equipped airship now in Great Britain and will be surpassed only by the ZR-2 when she is in commission.

It is an extremely advantageous arrangement for our Naval personnel to be able to make practice flights in the R-80, as her equipment is similar to that which will be installed in the ZR-2.

Flying Boat Handbooks for Sale

To meet an increasing demand for authentic aeronautical information the Navy Department has arranged for the sale at a nominal price of certain of the books which are used so successfully in the schools and stations of Naval Aviation.

These handbooks explain in detail the handling of large flying-boats with reference particularly to unpacking and assembling The titles of these handbooks which from now on may be obtained from the Superintendent of Documents, Washington, D. C., are as follows:

"HS-1 Flying-boat Handbook" (price 30 cents) a book of 40 pages and 27 charts or plans.

"H-16A Flying-boat Handbook" (price 30 cents) containing 41 pages and 30 plans and diagrams

"F-5-L Flying-boat Handbook" (price 65 cents) embracing 47 pages and 9 diagrams.

As used by Naval Aviation, these handbooks cover every phase of unpacking, assembling, and handling the three types of boats mentioned, and are undoubtedly the most exhaustive treatise obtainable on the subject.

English Cross-Channel Services Resumed

As a result of the intervention of the British Air Ministry the English cross-channel air services, which had been discontinued on March 1, have resumed operation on a temporary agreement.

General Menoher on Commercial Aeronautics

Commenting on the National Southern Air Tournament at Belleair, Florida, Maj Gen. Charles T. Menoher, Chief of Air Service, said:

"The Air Service sees in commercial aeronautics a solution of at least one great problem confronting the world today The nations inherited from the war a perplexing economic condition and a more or less undefined fear that security in the future was even more necessary than in the past.

"The development of the use of aircraft in war demonstrated to the satisfaction of military leaders that the air controls both land and water— that the first (and possibly the last) battle of the next war will be fought in the air. If this is true(and I believe that it is), then the airplane would seem to be the most potent weapon ever produced by man. If, however, the function of the airplane began and ended with its military use, its existence might appear to be lamentable rather than an adjunct to progress.

"But this is not all. The use of aircraft during the conflict placed aerial navigation before the eyes of all people and opened up wonderful possibilities. The airplane offers to commerce more in a constructive capacity than it does to the Army or the Navy in a destructive It provides the fastest means of transportation It eliminates physical frontiers. It carries people and freight great distances, swift almost as thought, increasing the range of influence of the world's leaders, and thus goes far toward eliminating that sterner and more dangerous frontier, which has often been the heaviest contributor to international difficulty—the frontier of ignorance and prejudice.

"This is not fancy. It is already in process of realization. Aircraft have carried the American mails from coast to coast in 33 hours and one of our military pilots has compassed the same distance in 22 hours. The air has brought us within days of our territory in Alaska on the north and the Panama Canal on the south. It has placed Europe much nearer and the Air Service hopes, before long, to see the Pacific flown, not in one uninterrupted voyage, of course, for in the present state of the art this is impossible, but in a series of 'hops' from California to Hawaii, to Guam and thence to the Philippines.

"When this is accomplished, the unity of mind between America and Asia should be increased, for with closer contact and a mutual attraction to commercial ends, there is certain to be less misunderstanding and keener appreciation. The sooner West and East are brought nearer, the sooner will economic differences be seen as possible of adjustment.

"So much for commercial flying as directly applied to business. Its relation to the national defense follows as a matter of course No nation can hope to maintain sufficient military aircraft to control the atmosphere Control must come through commercial development. If it is true that there can be no security without aviation, then it is equally true that there can be no aviation without commercial aeronautics which provides a reserve in production facilities and in trained personnel.

"Of all the wonderful developments credited to the world war, in aircraft alone do we find an instrument which justifies itself first in the productive activities of peace. Its certain position in future economic phases makes even more certain its utilization as a dominant factor in the next war The Air Service consequently feels that the advancement of commercial flying—its encouragement, control and guidance—is a national duty Aerial tournaments should greatly increase public interest and knowledge and consequently hasten adoption of a sound aeronautical policy."

Notice to Aviators, 1921, No. 3

Notice to Aviators, 1921, No 3, issued by the Hydrographic office of the U S Navy, lists information on aviation facilities available at the Aeromarine Field at Keyport, N J., on Raritan Bay; at Hampton Roads and Chesapeake Bay; at Grass Valley, Woodland, Modesto, Fort Bragg, Susanville, Redding and Richmond, all in California; and at Hilo Bay, H T and Molokai Island, H T

Information is also given on the daily forecasts of flying weather conditions which the Weather Bureau issues.

New Contemporaries

The steady growth of aeronautical efforts all over the world is well illustrated by the number of new aviation magazines which have appeared in the last year Some of these existed before the Great War, but they had to suspend publication while the conflagration lasted Now they are reappearing again and many new magazines have joined their ranks.

AVIATION AND AIRCRAFT JOURNAL recently received sample copies announcing the appearance of three such newcomers. By a curious coincidence all three publications are called "Aviation" in the language of the respective countries One is *Letectvi*, the official organ of the Czecho-Slovak Aero Club, and is published monthly at Vystaviste, Prague, Czecho-Slovakia. Another is *Hiko*, the official organ of the Imperial Aero Society of Japan, with publication offices at 1, Yurakucho, Kojimachi Ku, Tokio, Japan. This magazine, which is entirely printed in Japanese, announces itself with the following statement —

"We have the honor to inform you that the civil aviation in Japan is going to develop now, a-days, so that we have need to import foreign machines, motors, and accessories, which should be excellent. The present situation being like that, we hope you will advise your works in our Monthly Magazine "Hiko" which is the organ of the Imperial Aero Society of Japan representing the Empire's civil aviation in the International Aeronautic Federation, and it is the only best and most popular Magazine in the Empire, and we have now about thirty thousand readers among which are aircraft constructors, military and naval officers, business men, scientists, noblemen, etc."

The third newcomer in the field of aeronautical journals is *Aviacion*, of Tucuman 528, Buenos Aires, Argentine Republic This magazine, which is published monthly, is the official organ of the Centro Pro Aviacion Civil, a civilian organization which has for its purpose the development of Argentine aviation through training and propaganda work.

To all its new contemporaries AVIATION AND AIRCRAFT JOURNAL extends its best wishes for success and prosperity

Ae. C. A. Opens Club House at Flying Field

The Aero Club of America has accepted the offer of the Curtiss Co to fit up the Officer's Club at Hazelhurst Field for the members of the Aero Club of America. The Club House will be ready by the 15th of May and will be comfortably furnished for the convenience of the members of the Club and their guests, many of whom have arranged for keeping of their airplanes at the field, and accommodations will be provided for visiting aviators from the different clubs of the country. Arrangements are also being made so members of the Club and their guests may take flights and reserve officers, in cooperation with the government, have the use of government machines.

Change of Address

R. O. Smith Tool and Mfg Co., manufacturers of labor-saving tools and appliances, formerly of 315-317 Market St., Newark, N J, have moved into a large and convenient factory located at 245-247 N J R. R. Ave., Newark, where they will engage on a large scale in the manufacture of their recently developed Standard Radius Lathe and Planer Tool. Each set of these includes the excellent Smith "cutting-off tool" and threading tool. The company is also fully equipped for the manufacture of special tools, moulds, dies, jigs, gauges and fixtures.

Balloon Club Proposed Near New York

A group of lighter-than-air men is desirous of establishing in the vicinity of New York a sporting club provided with a balloon field from which periodical ascensions could be made by its members. So far only tentative discussions have been going on with respect to this subject, but it is believed that a recently perfected process of generating good gas at very low cost would make such a club a successful proposition. Lighter-than-air men interested in the matter should communicate with Ralph H. Upson, 22 East 17th Street, New York.

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